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# Tijdschrift voor Entomologie

A journal of systematic and evolutionary  
entomology since 1858



**Netherlands Journal of Entomology**

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A journal of systematic and evolutionary entomology since 1858

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LARVAE OF NEOTROPICAL *BEROSUS* (COLEOPTERA,  
HYDROPHILIDAE): *B. AULUS* ORCHYMONT, 1941  
AND *B. AURICEPS* BOHEMAN, 1859

Archangelsky, M., 1999. Larvae of Neotropical *Berosus* (Coleoptera, Hydrophilidae): *B. aulus* Orchymont, 1941 and *B. auriceps* Boheman, 1859. – Tijdschrift voor Entomologie 142: 1-8, figs. 1-16. [ISSN 0040-7496]. Published 22 September 1999.

The larval stages of the Neotropical *B. aulus* Orchymont, 1941 and *B. auriceps* Boheman, 1859 are described and illustrated for the first time; comparative notes between first and third instar larvae, and information on their biology is included. Morphological characters to differentiate third instar larvae of *B. aulus* and *B. auriceps* from other known New World *Berosus* larvae are discussed.

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Key words. – Hydrophilidae; *Berosus*; larvae; biology; Neotropical.

*Berosus* Leach, 1817, is one of the most species-rich genera of hydrophilids. In the New World there are over 130 species, and in South America alone there are some 80 species. Most of the larval descriptions of *Berosus* species are from the Nearctic region (Richmond 1920, Wilson 1923, Van Tassell 1966, Archangelsky 1994, 1997). Almost nothing is known on Neotropical *Berosus* larvae; Spangler (1966) published the only description of a South American larva, an undetermined specimen from Perú.

In this paper the larvae and egg cases of two species, *B. aulus* Orchymont, 1941 and *B. auriceps* Boheman, 1859, are described for the first time; at the same time notes on their biology are included. Both these species belong to the *auriceps*-group, defined by Oliva (1989, 1993) on several adult characters such as the presence of an adhesive sole on the basal segment of male fore tarsi, and the shape of the male genitalia (having a cylindrical aedeagus with paramere parallel, acuminate or bluntly narrowed, and a thick median lobe curved towards the tergal side). The *auriceps*-group is formed by fairly large species, and it contains three Neotropical species: *B. aulus*, *B. auriceps*, and *B. ethmonotus* Oliva, 1989.

*B. aulus* is endemic of Argentina, known from central and western parts of this country (provinces of Córdoba, San Luis, San Juan and La Rioja); *B. auriceps* has a more widespread distribution, both north-western and northern (parts of Brasil and Paraguay, and Argentina: provinces of Catamarca, Córdoba, La Rioja, Salta, Jujuy, Tucumán and Misiones).

#### MATERIAL AND METHODS

Except for one larva of *B. aulus*, associated with adults, all the others were reared from adults collected in the field and brought alive to the laboratory. Adults were placed in plastic containers (20 cm long × 10 cm wide × 8 cm high) with gravel, small pieces of wood, and some aquatic plants from the collecting site. Adults fed on the plant material and on some commercial fish food which was provided two or three times a week (to add some protein to the diet).

Egg cases were constructed on small rocks, pieces of bark or on the vegetation, always below the water's surface. After hatching, larvae were placed in small, individual containers; tissue culture plates with 12 cells (for first and second instars) and six cells (for third instars) were ideal for this purpose. Each cell had some sand and a couple of small sticks; the depth of the water was kept between 5 and 8 mm, and it was changed every other day. Larvae were fed chironomid larvae, small oligochaetes, ostracods and other small invertebrates. No pupae could be obtained from any of these two species.

The material was fixed with boiling water and stored in 75% ethyl alcohol. Larvae were cleared in lactic acid, dissected and mounted on slides for observation and description; the medium used was Hoyer's. Drawings were done using a Leica DML compound scope with camera lucida.

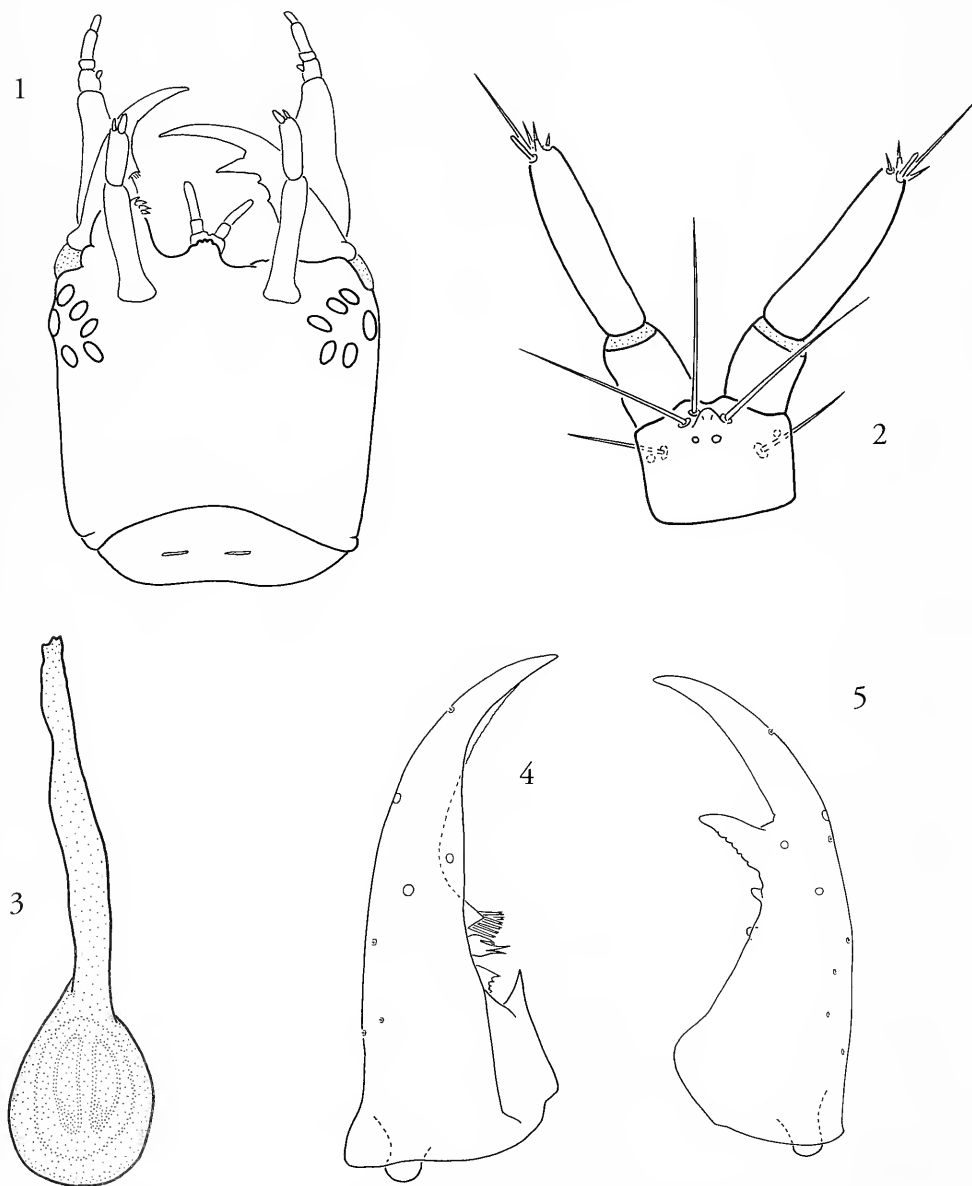
# DESCRIPTIONS

## *Berosus aulus* Orchymont, 1941

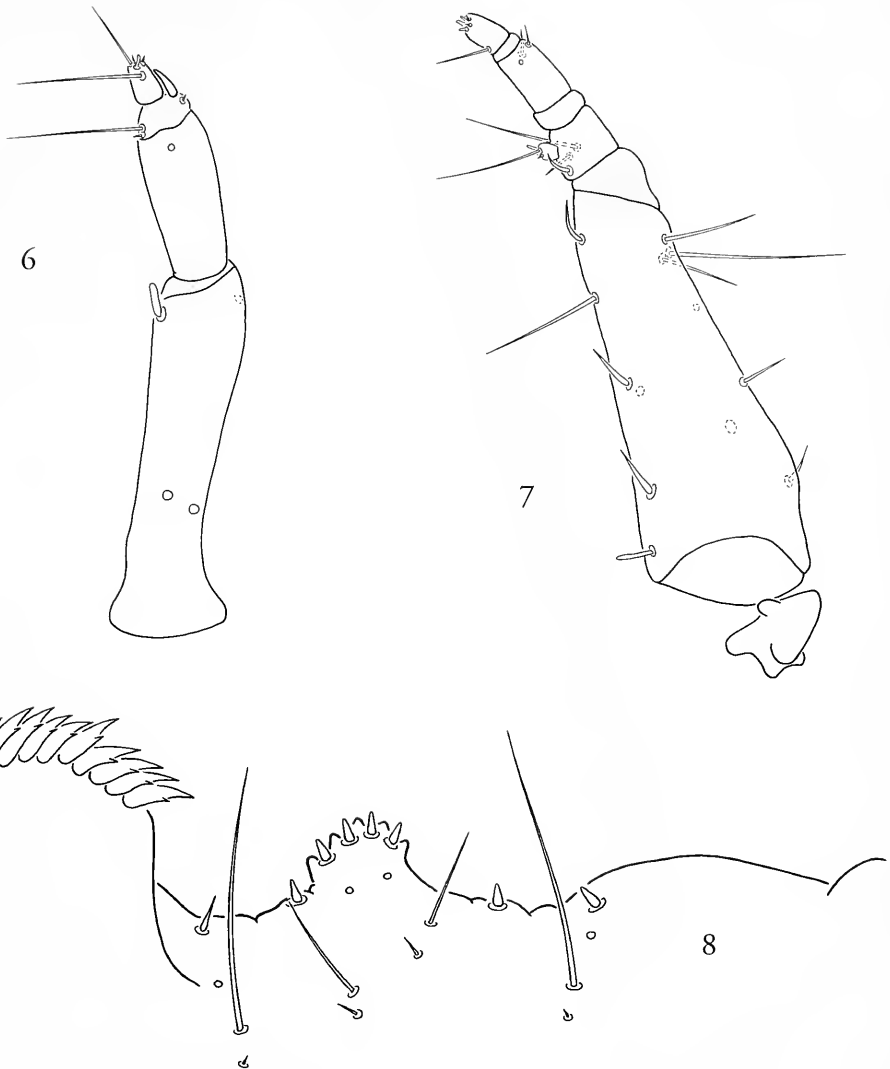
Material studied. – Argentina, La Rioja, Departamento Felipe Varela, Cuesta de Miranda (ruta 40, km 528), 3.X.1998, 29° 21' 40" S, 67° 47' 30" W, 1830 m (16 larvae); La Rioja, Departamento Felipe Varela, Cuesta de Miranda (ruta 40, km 517), 7.IV.1998, 29° 26' 42" S, 67° 49' 52" W, 1600 m (1 larva).

## Egg case

Size: 1.6-2.0 mm long by 1.0-1.4 wide (without mast); eggs 1.0-1.1 mm long. Whitish, attached to rocks and pieces of wood on the bottom of the aquarium. Made of two layers, first one laid on substrate, second one covering eggs. Final shape elliptical (fig. 3), with mast two to three times the length of the egg case. Eggs easily seen through the silk cover, usually



Figs. 1-5. *Berosus aulus*. – 1, Head, dorsal view; 2, labium, dorsal view; 3, egg case; 4, left mandible; 5, right mandible.



Figs. 6-8. *Berosus aulus*. — 6, Right antenna, dorsal view; 7, right maxilla, dorsal view; 8, labroclypeus, dorsal view.

two eggs per case (sometimes only one), always side by side.

### Third instar larva

Size: 8.5-11.0 mm long. Colour creamy-yellow, sclerotized areas light brown. Abdomen bearing seven pairs of tracheal gills; body covered by fine and short pubescence.

Headcapsule subquadrangular (fig. 1), epicranial sulcus not defined; cervical sclerites present, very narrow. ocular areas with six stemmata on each side, arranged as in fig. 1.

Labium slender (fig. 2). Prementum small and sub-pentagonal, with reduced ligula on dorsal side; one long seta on each side of ligula (two on left side in specimen illustrated); ventral side of prementum with one long seta at base of each palp. Palpi two-segmented, basal segment short, distal segment twice as long as basal one, bearing five apical setae.

Mandibles (Figs. 4 and 5) asymmetrical. Right one with three teeth on inner margin, distal one large and serrated, remaining two small and blunt. Left mandible with four teeth, basal one sharp and pointing upwards; second tooth pointing mediad, with

sharp inner edge; third one irregularly trifurcated; distal tooth triangular, pointing mediad and bearing a group of stout, comb-like spines. Distal inner edge of both mandibles slightly serrated.

Antennae three-segmented (fig. 6). Basal segment longer than other two combined, with strong and blunt subapical seta on inner margin. Second segment bearing three subapical setae, one short and one long on inner margin and a short one on outer margin; also carrying a long and narrow sensory appendage, slightly shorter than last segment of antenna. Third segment the shortest, with four apical setae (three short and one long) and one long subapical seta projecting mediad.

Maxillae (fig. 7) five-segmented, with short, irregularly shaped cardo. Stipes stout and long, with ten setae, five on inner margin and five on outer margin. Palp four-segmented, first segment subquadrate, bearing one curved seta on inner margin and two slender setae on ventral side; also bearing a small, sclerotized appendage that bears three apical setae. Second segment short, lacking setae; third segment the longest of palp, with two subapical setae, one on outer margin and one on ventral side; last segment with one long basal seta, projecting mediad, and six or seven short apical setae.

Labroclypeus asymmetrical (fig. 8), with a small nasale projecting forward. Nasale with five small blunt teeth arranged in semicircle; four short setae intercalated with nasale teeth, two more setae on each side of nasale, towards epistomal lobes. Lateral lobes of epistome strongly asymmetrical; right one not developed, lacking setae; left one large, covering base of mandible, projecting further than nasale, with 14 strong and curved spines, five outer ones simple, remaining nine with small median tooth.

Pronotum strongly sclerotized, subdivided by fine sagittal line. Mesonotum with two pairs of subtriangular sclerites, inner pair much narrower and smaller than outer one; metanotum lacking sclerites. Prosternum with a large subrectangular sclerite, divided by sagittal line; meso- and metasterna without sclerites. Meso- and metathoracic segments each with lateral tubercle.

Legs five-segmented, long, easily seen in dorsal view. First pair the shortest, third pair the longest. Coxae widely separated and elongate; trochanters small, subtriangular; femora slightly longer and slender than coxae; tibiotarsi slender, as long as coxae; pretarsal claw long and slender, curved inwards and bearing strong subbasal spine.

Abdomen ten-segmented. Segments nine and ten strongly reduced, segment eight small, subtriangular, with a subcircular tergite. Segments one to seven similar in shape, tapering towards distal end, each segment subdivided by transverse fold and bearing a long,

slender tracheal gill on each side; small conical tubercle present at base of each tracheal gill, carrying non-functional spiracles. Segments one and two with two pairs of setiferous tubercles on dorsal view; segments three to seven with only one pair of dorsal tubercles.

### Comparative notes on first instar larvae

Epicranial sulcus shaped as an inverse bell; cervical sclerites rudimentary but present; stemmata smaller. Labroclypeus different to that of third instars, nasale with three teeth (outer two not developed). Antennae shorter and wider, especially basal segment. Maxillae similar to third instars, except for stouter stipes. Basal tooth of left mandible with several sharp cuticular spines extending to base of mandible, serration coarser than in third instars; right mandible with distal end slightly serrated. Ligula of labium larger, projecting past base of palpi. Thorax and abdomen similar but sclerotization less developed; tracheal gills longer in relation to body; pubescence more sparse; distribution of tubercles similar to third instars.

### Bionomical notes

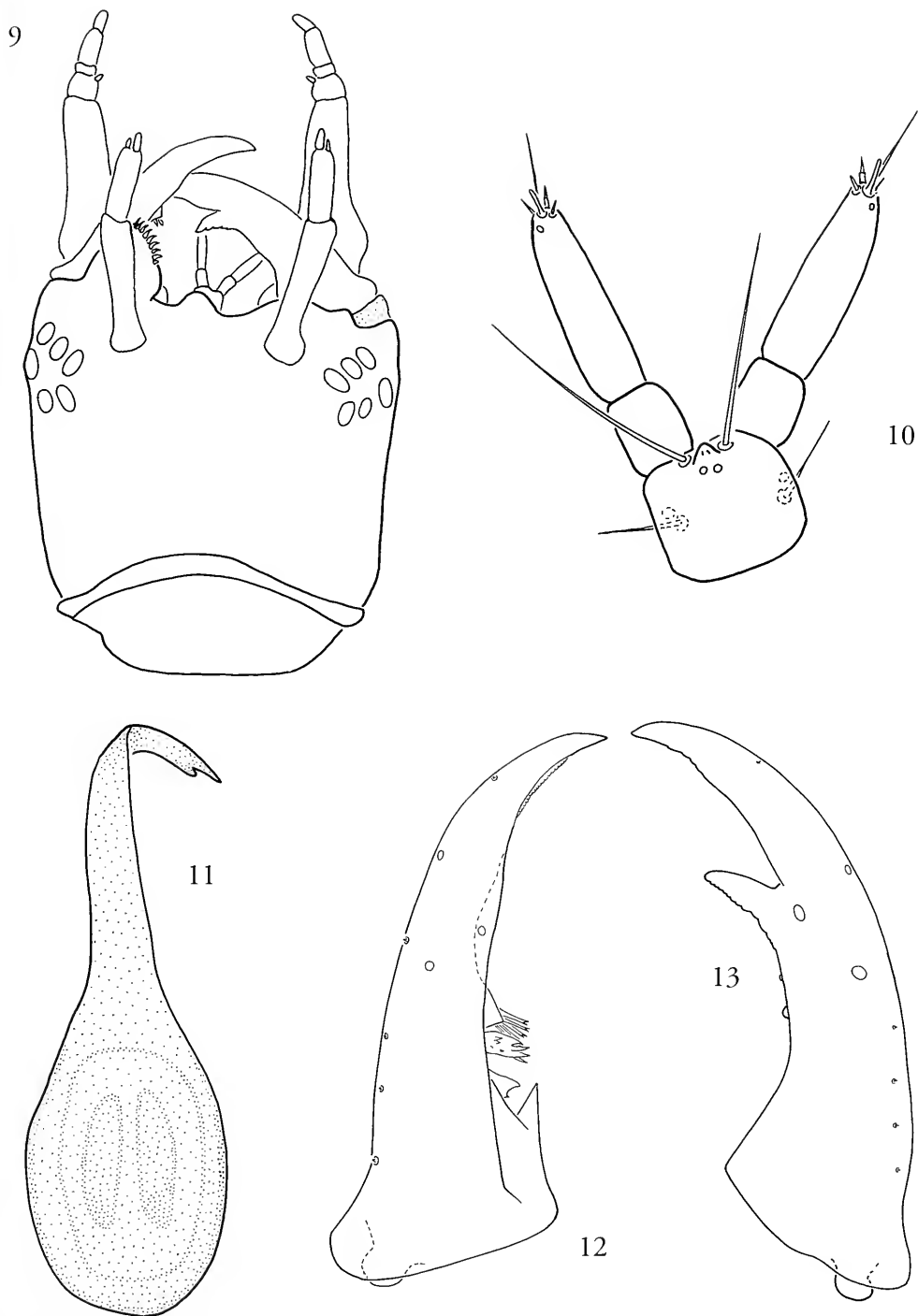
*B. aulus* adults were collected in pools formed along small creeks in the Famatina Mountains range; the bottom of the pools was covered by sand and fine reddish mud, with little vegetation on the margins. The egg cases were always built on the bottom of the aquaria, on rocks and pieces of bark or small sticks; they were always constructed at night. The duration of the different stages was as follows: five to six days for the eggs to hatch, 12 to 15 days for first instar larvae to moult into second instar, and 17 to 20 days for these to moult into third instars. Pupae were not obtained. The larvae fed mostly on small invertebrates, but when food was not available they fed on detritus, which was a mixture of algae (cyanobacteria and diatoms) with rhizopods, nematodes, and very small oligochaetes. Those larvae that fed on only a detritus diet stayed alive for a long time, but their development stopped (no moults were registered); development resumed after they were fed with chironomids and other invertebrates.

### *Berosus auriceps* Boheman, 1859

Material studied. – Argentina, La Rioja, Departamento Castro Barros, Chuquis, 18.XI.1998, 29° 09' 45" S, 67° 04' 48" W, 1300 m (5 larvae).

### Egg case

Size: 1.8–2.2 mm long by 1.1–1.3 mm wide (without mast); eggs 1.1–1.2 mm long. Very similar to that of *B. aulus*, slightly larger (fig. 11), silk cover thinner than that of *B. aulus*.



Figs. 9-13. *Berosus auriceps*. – 9, Head, dorsal view; 10, labium, dorsal view; 11, egg case; 12, left mandible; 13, right mandible.

### Third instar larva

Size: 9.1-10.0 mm long. Similar in appearance to *B. aulus*, also with seven pairs of tracheal gills but shorter, pubescence also shorter, body shiny.

Headcapsule subquadrangular (fig. 9), similar to that of *B. aulus* but without cervical sclerites.

Labium with subquadrate prementum (fig. 10); ligula and palps similar to those of *B. aulus*.

Mandibles (Figs. 12 and 13) similar to *B. aulus*; left one with third tooth from base tetrafurcated and with few basal spines; right one similar except for basal two inner teeth, less developed, second one very reduced, almost vestigial.

Antennae three-segmented (fig. 14), very similar to those of *B. aulus*, sensory appendage of *B. auriceps* slightly shorter.

Maxillae five-segmented (fig. 15), cardo larger than that of *B. aulus*, with large outer flap that articulates with headcapsule. Remaining segments and chaetotaxy similar to *B. aulus* except for first palpal segment which is not completely sclerotized in *B. auriceps*.

Labroclypeus asymmetrical (fig. 16), nasale less developed than in *B. aulus*, not projecting further than lateral lobes of epistome, with only three blunt teeth; four blunt setae intercalated with teeth of nasale. Right epistomal lobe rounded, left lobe strongly developed, with 13 or 14 strong spines, four or five outer ones simple, remaining nine with a small inner tooth.

Thorax and abdomen similar in shape to *B. aulus*. Abdominal segments subdivided by two transverse folds instead of one. Tergal plate of segment eight suboval, more elongated than in *B. aulus*. Abdominal segments one to three with two pairs of setiferous lobes, segments four to seven with only one pair.

### Comparative notes on first instar larvae

Epicranial suture shaped as an inverse bell; cervical sclerites also absent; stemmata large. Nasale with two blunt teeth; right lobe of epistome not developed. Left mandible with coarser serration, basal tooth with some cuticular spines on ventral side; right mandible with two basal teeth well developed. Antennae shorter and wider. Maxillae with a stouter stipes. Thorax and abdomen similar in shape; pubescence sparse; tracheal gills proportionally longer; distribution of setiferous lobes different than in third instar larvae, with two pairs in segments one and two, and one pair in segments three to seven.

### Bionomical notes

*B. auriceps* adults were collected in pools formed by permanent emerging underground water, with a dense vegetation formed principally of grasses and algae. Very few egg cases and larvae were obtained, so the following observations should be taken cautious-

ly. The egg cases were laid on small rocks, pieces of bark and also grass. The development of this species was a little slower than in *B. aulus*, six to seven days for the larvae to hatch, 15 to 17 days for the first instars to moult into second instar, and 20 to 25 days for these to moult into third instars. They were predatory and fed on chironomid larvae, ostracods and small oligochaetes.

### COMPARATIVE NOTES WITH OTHER KNOWN NEW WORLD BEROSUS SPECIES

Few are the descriptions of New World *Berosus* (Archangelsky 1994, 1997), six of them are from the Nearctic Region: *B. peregrinus* (Herbst, 1797), *B. striatus* (Say, 1825), *B. pantherinus* LeConte, 1855, *B. corrinii* Wooldridge, 1964, *B. hoplites* Sharp and *B. pugnax* LeConte, 1863, and one unidentified larva from Perú (Richmond 1920, Wilson 1923, Spangler 1966, Archangelsky 1994, 1997).

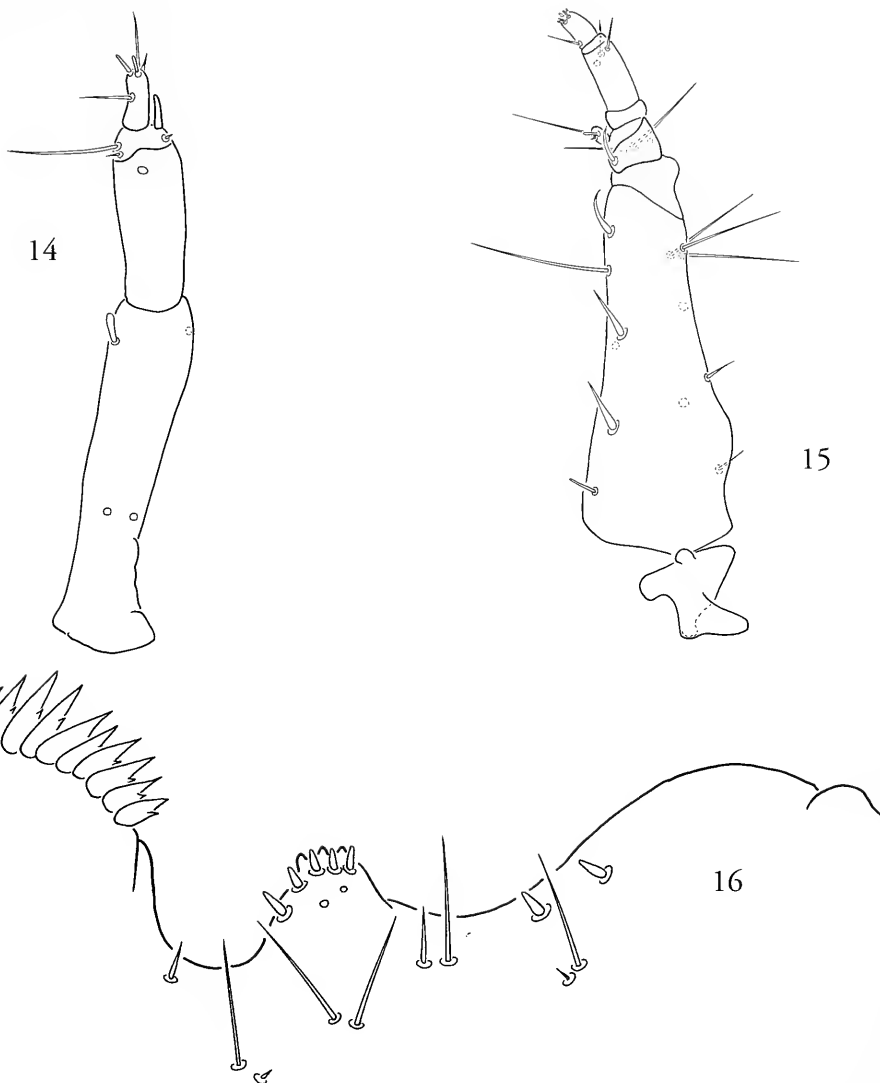
*Berosus* larvae are very homogeneous in their morphology, up to now the most distinct morphological structures that seem useful to tell species apart are the labroclypeus (shape and size of nasale and epistomal lobes), the mandibles (number and shape of inner teeth), and the antennae (size of the sensorium).

Third instar larvae of *B. auriceps* can be easily separated from those of *B. aulus* with the following characters. *B. auriceps* has a nasale with three small teeth, and it does not project further than the right epistomal lobe. *B. aulus* has five teeth on the nasale, and it projects further than the right epistomal lobe. The antennae and mouthparts on the other hand are very similar, one difference is that the left mandible of *B. aulus* has a trifurcated inner tooth, while the same tooth in *B. auriceps* is tetrafurcated.

A few comparisons can be made with some of the known Nearctic larvae. *B. pugnax* is easy to tell apart since it only has four pairs of abdominal tracheal gills, other differences are the two smaller basal teeth on the right mandible, larger and sharper than those of the two species from Argentina; the nasale has three teeth, but the setae intercalated with them are much longer than those of *B. auriceps*; the left epistomal lobe of *B. pugnax* has only 11 spines on its margin, while *B. aulus* and *B. auriceps* have 13 or 14 spines.

*B. hoplites* has a very different labroclypeus, with a flat nasale that bears a row of many small, irregular teeth that extend all the way to the right epistomal lobe, the number of spines on the left lobe is 18, of which the inner four or five are small and blunt, finally, the right mandible has only one small inner tooth (against three in the two species from Argentina).

The nasale of *B. corrinii* is similar to that of *B. aulus*,



Figs. 14-16. *Berosus auriceps*. – 14, Right antenna, dorsal view; 15, right maxilla, dorsal view; 16, labroclypeus, dorsal view.

with five teeth, but that of *B. aulus* is narrower and projects further than the one of *B. corrini*; both species have 14 spines on the left epistomal lobe, but *B. aulus* has the inner nine with a distal toothlet while *B. corrini* has only the inner six with a toothlet; regarding the right mandible, *B. corrini* only has two inner teeth (*B. aulus* has three).

One difference that third instars of both *B. aulus* and *B. auriceps* share is a short sensory sensorium on the second antennal segment, much shorter than the third segment, the three Nearctic species previously

mentioned have a sensorium almost as long as the third antennite.

Comparative notes with the other three Nearctic *Berosus* are difficult to make since I have not seen material from them, Wilson's (1923) descriptions and illustrations are not very detailed, and that of Richmond (1920) is based on a first instar larva. One difference mentioned by Wilson (1923) is that the stemmata in *B. striatus* are placed on the basal half of the headcapsule while in the remaining species they are placed distally, close to the base of the antennae.

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I want to thank Dr. Adriana Oliva for verifying the identification of the adult specimens, and Dr. M. Hansen for his suggestions.

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# MORPHOLOGY AND EVOLUTION OF THE LARVAL HEAD OF HYDROPHILOIDEA AND HISTEROIDEA (COLEOPTERA: STAPHYLINIFORMIA)

R. G. Beutel, 1999. Morphology and evolution of the larval head of Hydrophiloidea and Histeroidea (Coleoptera: Staphyliniformia). – Tijdschrift voor Entomologie 142: 9-30, figs. 1-29, table 1. [ISSN 0040-7496]. Published 22 September 1999.

Internal and external features of the larval head of *Spercheus emarginatus*, *Hydrochus* sp., *Helophorus* sp., and of *Hister* sp. are described in detail. Character transformations of these structures apparently play an important role in the evolution of Hydrophiloidea and Histeroidea. A basal position of Spercheidae within this lineage of Staphyliniformia is suggested by a considerable number of plesiomorphic features: head subprognathous, adnasalia and nasale absent, gula broad and short, posterior tentorial arms arise close to hind margin of head capsule, tentorial bridge fairly broad and straight, maxillary groove deep, with well developed articulating membrane, unidentate mandibular retinaculum, cardo undivided, moveability between cardo and stipes fully retained, stipes not tube-like, maxillary palp inserted laterally, lacinia strongly developed and hook-like, prepharynx short, anatomical mouth dilatable, brain located within head capsule, glands present in labial region. Some of these character states are also found in larvae of *Hydrochus* but not in other larvae of Hydrophiloidea and Histeroidea. A cladistic analysis, which is exclusively based on larval characters, results in the following branching pattern (strict consensus tree): Scarabaeidae + (Agyrtidae + Leiodidae + Hydraenidae + (Spercheidae + (Hydrochidae + (Histeridae + Synteliidae + Sphaeritidae) + (Helophoridae + ((Georissidae + Epimetopidae) + Hydrophilidae))))). A monophyletic unit which comprises Histeroidea and subgroups of Hydrophiloidea is in contrast to other phylogenetic hypotheses. It cannot be fully excluded that derived character states which are related with predacious habits have independently evolved in both superfamilies.

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Key words. – Morphology; larval head; Hydrophiloidea; Histeroidea; phylogeny.

Hydrophiloidea is a superfamily of the polyphagan series Staphyliniformia (Lawrence & Newton 1995, Hansen 1997a) and comprises about 2400 described species (Hansen 1991). Adults are found in aquatic, semiaquatic, or terrestrial habitats, and some representatives of the subfamily Sphaeridiinae have specialised on life in dung or decaying matters (Hansen 1997b). In most cases, larvae are found in the same environment as the adults. However the feeding habits differ considerably. Adults rely on various sorts of plant material, mainly decaying tissue (Hansen 1997b), whereas larvae of most subgroups are carnivorous (Böving & Henriksen 1938, Bertrand 1972, Hansen 1997b).

A sister group relationship between Histeroidea and Hydrophiloidea was postulated by Hansen (1997a). However, the life styles of both groups are clearly different. All stages of Histeroidea are terrestrial and the adults are predominantly or exclusively predacious (Hansen

1997b). Hydrophiloid larvae hatch from a silk cocoon whereas eggs are deposited uncovered by histeroid females. The larvae of both groups are carnivorous and develop fast. However, histeroid larvae seem to be specialized on maggots (Newton 1991), a food preference which is also found in some sphaeridiines but not in other groups of Hydrophiloidea.

The systematic concept of the superfamily Hydrophiloidea, the interrelationships of subgroups, and the affinities with Histeroidea were discussed controversially in older and more recent studies (Böving & Craighead 1931, Crowson 1955, Lawrence & Newton 1982, 1995, Hansen 1991, 1997a, Beutel 1994, Archangelsky 1998). The phylogenetic analyses presented by Hansen (1991, 1997a) are based on many external features of adults and some external characters of larvae. External features of immature stages were also described and analysed by Archangelsky (1997, 1998). Internal features of larvae (and adults)

are treated in very few studies and not in great detail (e.g. Quennedey 1965, Moulins 1959). They were not considered in cladistic analyses so far. Important structural and functional transformations of the larval head have apparently taken place in the evolution of Hydrophiloidea (Beutel 1994). Therefore, this contribution is aiming at an improved knowledge of the anatomy and morphology of larvae in order to provide a broader basis for phylogenetic analyses.

The cladistic analysis presented in this study is mainly aiming at a more reliable character state polarity assessment. The results have to be considered as preliminary for several reasons. Only larval features, mainly of the head are included. Different higher ranking taxa are only represented by the larvae of one or a few species examined (e.g. Hydrophilidae, Histeridae) and many data concerning internal features are missing. This is due to the general lack of anatomical studies and the restricted availability of larvae, especially of material suitable for histological work. Detailed study of internal structures of larvae of Hydrochidae, Georissidae, Epimetopidae, Synteliidae, and Sphaeritidae should be considered as an important future project.

#### MATERIAL AND TECHNIQUES

##### Species examined

###### Hydraenidae:

*Davidraena* sp.

*Hydraena* sp.

*Ochthebius* sp.

###### Agyrtidae

*Necrophilus hydrophiloides*

Guérin-Menneville, 1835

###### Silphidae

*Silpha obscura* Linnaeus, 1758

###### Spercheidae

*Spercheus emarginatus* (Schaller, 1783)

###### Hydrochidae

*Hydrochus elongatus* (Schaller, 1783)

*H. megaphallus* Berge Henegouwen, 1988

*H. ignicollis* Motschulsky, 1860

(mounted on slides)

###### Helophoridae

*Helophorus* sp.

*H. aequalis* Thomson, 1868

*H. redtenbacheri* Kuwert, 1885 (3rd instar)

###### Georissidae

*Georissus crenulatus* Rossi, 1794

###### Sphaeridiinae

*Sphaeridium* sp.

###### Hydrophilinae

*Berosus* sp.

*Hydrochara caraboides* (Linnaeus, 1758)

*Hydrophilus piceus* (Linnaeus, 1758)

###### Histeridae

*Hister* sp. (?) (identified with Klausnitzer 1978, several genera are missing in the key)

*Hololepta aequalis* (Say, 1825)

###### Scarabaeidae

*Liocola* sp.

Specimens of *Spercheus emarginatus*, *Helophorus*, and *Hololepta* were embedded in Historesin, cut at 5 µm, and stained with methylene-blue and acid fuchsin. Available specimens of larvae of *Hydrochus* were mounted on microscope slides. Larvae of other taxa were dissected. Drawings were made using an ocular grid.

Von Kéler's muscular nomenclature is used in the text and the corresponding number are used in the illustrations (Von Kéler 1963).

The phylogenetic analysis was carried out using the cladistic computer programs PAUP version 3.1 (Swoford 1991) and MacClade version 3 (Maddison & Maddison 1992).

#### MORPHOLOGICAL RESULTS

##### *Spercheus emarginatus*

##### Head capsule, external features (figs. 1, 7)

Head slightly inclined, subprognathous, moderately compressed dorsoventrally, rounded laterally. Sclerotized parts brownish to testaceous. Setae unusually thin, distribution irregular (fig. 1). Dorsal side of head capsule covered with minute spines. Five stemmata present. Anteriormost stemma large, located on a prominent, anterolateral elevation. Posterodorsal stemma adjacent with an unpigmented, semitransparent area. Labrum fused to clypeus, posterior margin defined by indistinctly impressed transverse line. Clypeofrontal suture completely absent. Anterior tentorial grooves not apparent. Frontal suture very indistinct in 3rd instar larvae, obliterated posteriorly. Conspicuous transverse sulcus present in the posterodorsal area of the head capsule. Coronal suture absent. Maxillae inserted in deep maxillary grooves, with well developed articulating membrane (fig. 7). Distinct ridge present lateral to the maxillary grooves. Gula broad and sclerotized. Posterior tentorial grooves widely separated, fairly long and fissure-shaped, scarcely discernible externally.

##### Internal skeletal structures (figs. 13, 17, 21)

Posterior tentorial arms arise immediately close to hind margin of head capsule, connected with the postoccipital ridge posterolaterally. Tentorial bridge straight and fairly broad (figs. 17, 21). Anterior arms moderately strong. Dorsal arms normally developed, attached to dorsal wall of head capsule close to frontal suture.

**Labrum** (figs. 1, 13, 21)

Fused with clypeus, rounded anteriorly, without nasal or adnasal lobes. Lateral margin with several ventrally directed, triangular, sclerotized processes (fig. 21).

Musculature: absent

**Antenna** (figs. 1, 13)

3-segmented, anteriorly directed, fairly slender. Inserted on a conspicuous prominence resembling a basal antennomere. Antennomere I<sup>1</sup> strongly elongated. Antennomere II slightly shorter. Antennomere III slender, almost as long as II. Sensorial appendage absent.

Musculature (fig. 13). – M 1: M. tentorioscapalis anterior, O: dorsal tentorial arm, I: anteriorly on base of antennomere I; M 2: M. tentorioscapalis posterior, O: posterior to M 1 on dorsal tentorial arm, I: posteriorly on base of antennomere I; M 4: M. tentorioscapalis medialis, O: dorsal to M 2 on dorsal tentorial arm, I: dorsally on base of antennomere I.

**Mandible** (figs. 1, 7)

Fairly elongated and slender, falcate, with a very small retinacular tooth. Mola, prostheca, and penicillum absent. Narrow apical part with two pointed apices. Ventral apex continuous with a ridge which is set with a dense row of spines.

Musculature: M 11: M. craniomandibularis internus, strongest muscle of head capsule, O: extensive parts of dorsolateral area of head capsule, ventrally between M 15 and tentorium, I: adductor tendon; M 12: M. craniomandibularis externus, O: lateral wall of head capsule, I: abductor tendon.

**Maxilla** (figs. 7, 17)

Maxillary groove and articulating membrane well developed. Cardo transverse, undivided. Stipes fairly short and moderately broad, connected with cardo by a hinge. Basal part mesally open, not tube-like in cross section. Finger-shaped galea inserted on strongly elongated palpifer which inserts laterally on stipes. Lacinia strongly developed, hook-like, with a row of mesal spines apically. Palp 3-segmented, palpomere I short, I and III moderately elongated.

Musculature (figs. 17, 25). – M 15: M. craniocardinalis, fan-shaped, O: ventrolaterally from head capsule, close to postoccipital ridge, I: lateral edge of cardinal base by means of a short and broad tendon; M 17: M. tentoriocardinalis, strong muscle composed of several, almost vertical components, O: upper part of posterior tentorial arm, I: ventral surface of cardo; M 18: M. tentoriostipitalis, divided into two strong,

almost vertical bundles, O: posterior tentorial arm, below M 17, I: mesally and ventromesally on proximal part of stipes; M 19: M. craniolacinalis, O: posterolaterally from head capsule, I: base of lacinia; M 20: M. stipitolacinalis: absent; M 22: M. stipitopalpalis externus, O: mesally from stipes, lateral to insertion of M. craniolacinalis, I: ventrally on base of palpifer; M 23: M. stipitopalpalis internus, O: mesally from stipes, close to origin of M 22, I: anterodorsally on base of palpifer.

**Labium** (figs. 7, 17)

Submentum parallel-sided, posteriorly fused with gula. Posterior margin defined by anterior edge of posterior tentorial grooves. Mentum separated from submentum by broad membrane, anteriorly fused with prementum, laterally adjacent with maxillary grooves. Prementum narrow posteriorly, with large, conspicuous lateral lobes. With dense rows of spines along anterolateral margin. Palpomere I fused with anterior premental margin, very short, palpomere II moderately long, peg-like. Small and narrow sclerotized ligula present between palps. Posterior margin of dorsal premental wall set with a row of distinct spines.

Musculature (figs. 17, 21, 25). – M. 28: M. submentopraementalis, O: anterior part of submentum, I: ventromedially on base of prementum (fused mentum and prementum); M. 29: M. tentoriopraementalis inferior, O: base of posterior tentorial arm, I: posterior margin of prementum, immediately lateral to M 28; M 30: M. tentoriopraementalis superior, O: posterior tentorial arm, above M. 29, I: ventral surface of prementum, anterior to M. 29; considering the unusual ventral insertion, it cannot be excluded that this muscle is a part of M. 29; this would imply loss of M. 30. M 34: M. praementopalpalis ext.: not clearly identified.

**Epipharynx** (figs. 13, 21, 24)

Anterior epipharynx lightly sclerotized, testaceous, without setae or spines. Not fused with hypopharynx laterally, forming a voluminous cibarial chamber together with mandibles, maxillae and labium. Posterior-most epipharyngeal part laterally fused with hypopharynx, thus forming a very short prepharyngeal tube.

Musculature (figs. 21, 24). – M 43: M. clypeopalatalis, strong muscle, composed of 3 subcomponents; M 43a, O: anterolateral clypeal region, I: anteromesal region of epipharynx; M 43b, composed by three bundles, O: mesal to M 43a, I: successively on epipharynx, posterior to M 43a, bundles separated

<sup>1</sup>The homology with the scapus of other insects is unclear due to the loss of one antennal segment in larvae of Polyphaga. Therefore the neutral term antennomere I was chosen.

by well developed transverse muscles; M 43c, O: anteromesal clypeal region, I: immediately anterior to anatomical mouth.

### **Hypopharynx** (figs. 17, 21)

Anterior part semimembranous, distinctly bulging, separated from dorsal wall of prementum by a deep fold. Short posterior part laterally fused with epipharynx. Posteriorly delimited by transverse sclerotized bar.

Musculature (figs. 17, 21, 25). – M 41: M. frontohypopharyngalis, divided into 2 bundles, O: anterolateral and posterolateral frontal region, I: posterolaterally on hypopharyngeal apodeme; M 42: M. tentorihypopharyngalis, composed of 2 components; M 42m, a strong, median muscle, O: tentorial bridge, I: ventrally on posterior hypopharyngeal margin; M 42l, a well developed, flat muscle, O: posterior tentorial arm, I: laterally on posterior hypopharyngeal margin.

### **Pharynx** (figs. 21, 24, 25)

Anatomical mouth dilatable by contraction of Mm 42m and 43. Pharynx extremely wide, dorsal, dorso-lateral and ventrolateral folds almost completely absent. Posteriorly adjacent with a strongly developed proventriculus (fig. 21).

Musculature (figs. 21, 24, 25). – M 45: M. frontobuccalis anterior, a broad and flat muscle, O: central frontal area, I: dorsally on pharynx, immediately posterior to strong ring muscle of anatomical mouth; M 46: M. frontobuccalis posterior, composed of 3 components; M 46a, O: frons, mesal to posterior component of M 41, I: laterally on pharynx; M 46b, composed of 3 bundles, O: posterior frontal area, I: dorsally on pharynx; M 46c, O: lateral to M46b, I: dorsally on pharynx, immediately anterior to cerebrum; M 52: M. verticopharyngalis: absent; M 52: M. tentorihypopharyngalis, composed of 2 bundles, O: laterally from tentorial bridge (fig. 8), I: ventrolaterally on pharynx. A well developed ring musculature is present over the whole length of the pharynx.

### **Cerebrum and suboesophageal ganglion** (fig. 21)

Cerebrum and suboesophageal ganglion located in posterior region of head capsule.

### **Glands** (fig. 25)

Tubular glands present posterior to prementum.

### **Proventriculus** (fig. 21)

A large proventriculus with internal folds and rows of spines is present posterior to the pharynx. It is star-shaped in cross section and equipped with extremely strong muscles.

## ***Hydrochus elongatus* (first instar larva)**

### **Head capsule, external features** (figs. 2, 8)

Head prognathous, parallel-sided, fairly short. Sclerotized parts testaceous. Labrum completely fused. Clypeolabral margin without distinct adnasalia and nasale. Clypeofrontal suture completely absent. Frontal and coronal suture not visible. One stemma present posterior to antenna<sup>1</sup>. Maxillary groove deep, articulating membrane present. Gula small, rectangular.

### **Internal skeletal structures** (fig. 2)

Strong anterior tentorial arms arise posterior to antennal base, connected with posterior arms which arise close to the foramen occipitale. Tentorial bridge and dorsal arms not identified.

### **Labrum** (fig. 2)

Anterior clypeolabral margin with a row of very short hairs, without distinct adnasalia and nasale.

### **Antenna** (fig. 2)

3-segmented, anteriorly directed. Antennomere I very long and broad. Distal part with short spines along mesal margin. Antennomere II very short, with mesal sensorial appendage. Antennomere III globulous.

### **Mandible** (fig. 2)

Very slender and falcate, with conspicuous asymmetrical retinacula. Left retinaculum with a strong, curved spur and 3 proximal spines. Right retinaculum with similar spur and a proximal row of 7 short spines. Strongly developed basal pseudomola set with few mesally directed very short hairs. Prostheca and penicillum absent.

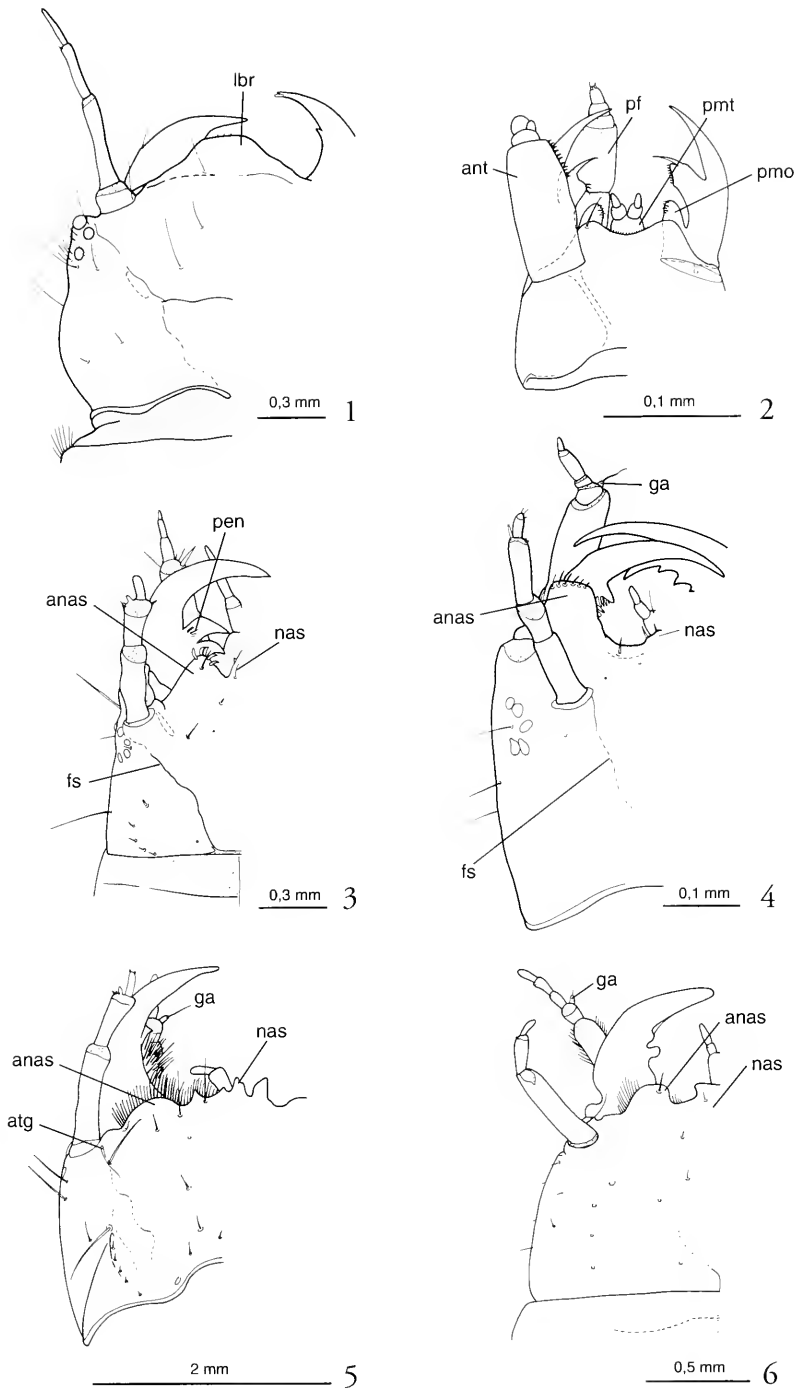
### **Maxilla** (fig. 8)

Maxillary groove deep, mesal articulating membrane well developed. Cardo large, composed of four separate sclerites. Distal part of maxilla antenniform. Stipes moderately long and parallel-sided. Mesally closed, thus forming a tube-shaped structure. Lacinia and galea completely absent. Palp 3-segmented. Palpifer very large and elongated, broadly connected with stipes. Palpomere I fairly broad and short. Palpomere II slightly longer. Palpomere III moderately elongated, apically rounded.

### **Labium** (fig. 8)

Submentum and mentum fairly elongated, inserted between maxillary grooves. Prementum fairly large. Palp short, 2-segmented. Ligula absent.

<sup>1</sup>Six very small stemmata, which are closely aggregated are present in 1st instar larvae of *Hydrochus rufipes* (Archangelksy, pers. comm.).



Figs. 1-6. Head, dorsal view. – 1, *Spercheus emarginatus*; 2, *Hydrochus elongatus*; 3, *Helophorus* sp.; 4, *Berosus* sp.; 5, *Hister* sp.; 6, *Hololepta aequalis*. Abbreviations: ant, antenna, anas, adnasalia, atg, anterior tentorial groove, fs, frontal suture, ga, galea, lbr, labrum, nas, nasale, pen, penicillum, pf, palpifer, pmo, pseudomola, pmt, praementum.

## Epipharynx

Anterior epipharynx covered with very short setae.

Structures of the digestive tract, glands, cerebrum, and suboesophageal ganglion could not be examined in the specimens available for this study.

## *Helophorus aequalis*

### Head capsule, external features (figs. 3, 9)

Head prognathous, broad, parallel-sided, wedge-shaped in lateral view. Sclerotized parts testaceous. Distribution of setae as in figs. 3 and 9. Labrum completely fused, anterior margin of head capsule with distinct rounded adnasalia and a median, triangular nasale. Clypeofrontal suture completely absent. Anterior tentorial grooves distinct. Clypeofrons strongly elongated, broadly reaches hind margin of head capsule. Frontal suture distinct, slightly irregular, U-shaped posteriorly, diverging anteriorly. Coronal suture absent. Six fairly small stemmata present. Maxillary groove present but strongly reduced. Narrow posterior tentorial grooves shifted to anteromedian region of head capsule, almost contiguous. Gula represented by a very indistinct, elongated suture and a median, internal sulcus.

### Internal skeletal structures (figs. 18, 22)

Basal part of posterior tentorial arms rather flat, almost contiguous, distant from hind margin of head capsule. Tentorial bridge not identified in *H. aequalis*, extremely thin or absent. Absent in larvae of *H. redtenbacheri*. Upper and anteriormost parts of posterior arms curved, extremely flattened, not strongly sclerotized. Anterior arms fairly thin, well sclerotized, approximately round in cross section. Dorsal arms strongly flattened, tendon-like.

### Labrum (figs. 3, 22)

Completely fused with clypeofrons, with rounded adnasalia with distinct, flattened, lancet-shaped setae and a pointed, triangular nasale. Ventral nasal teeth present, lateral teeth absent.

Musculature (fig. 22): absent

It cannot be excluded that the muscle identified as M. 43 a (M. clypeopalatalis a, see below) is derived from the labral muscle M. frontoepipharyngalis.

### Antenna (figs. 3, 14)

3-segmented, anteriorly directed. Antennomere I fairly long and broad, antennomere II slightly shorter, with two lateral appendages distally. Antennomere III distinctly shorter and slender.

Musculature (fig. 14). – M 1: M. tentorioscapalis anterior, O: posteriormost part of anterior tentorial arm, unsclerotized dorsal arm, head capsule, I: anteriorly on base of antennomere I; M 2: M. tentorioscapalis posterior, O: posterior to M 1 on posterior

tentorial arm, I: posteriorly on base of antennomere I; M 4: M. tentorioscapalis medialis, O: dorsal to M 2 on posterior tentorial arm, I: dorsally on base of antennomere I.

### Mandible (fig. 3)

Falcate, with elongate, pointed distal part and strong, bifurcate retinaculum. Anterior retinacular tooth with distinct group of short hairs on dorsal surface. Basal penicillum present. Mola, prostheca, and additional distal teeth absent.

Musculature (fig. 22). – M 11: M. craniomandibularis internus, extremely strong muscle, O: extensive parts of the dorsolateral, lateral, ventrolateral, and posteroventral areas of head capsule, I: adductor tendon; M 12: M. craniomandibularis externus, O: lateral wall of head capsule, I: abductor tendon.

### Maxilla (fig. 9)

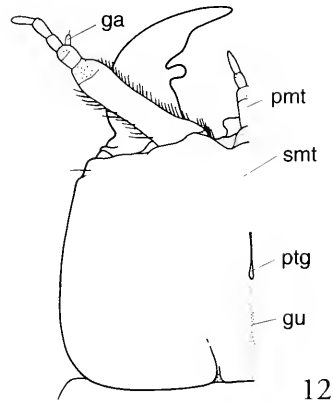
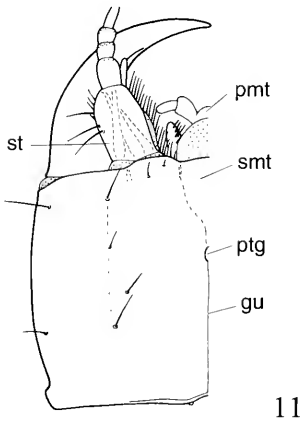
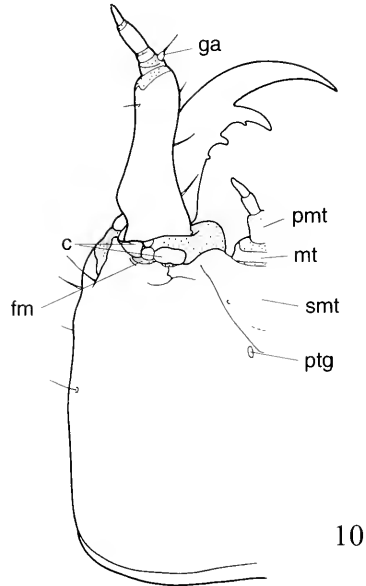
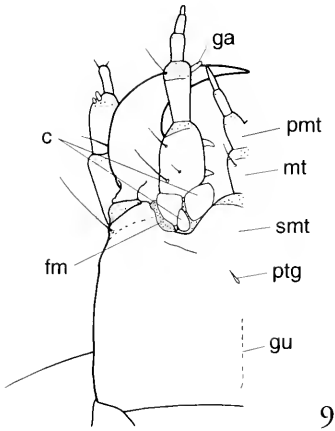
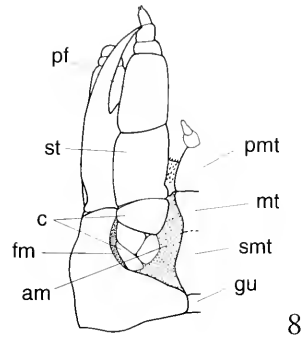
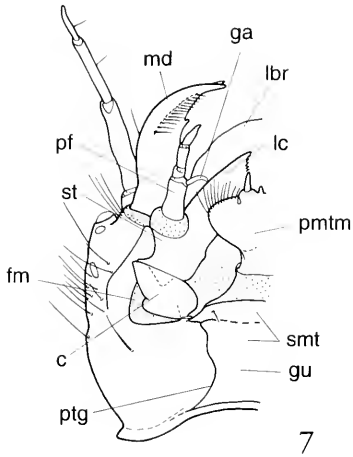
Maxillary groove distinctly reduced. Articulating membrane almost completely absent. Cardo fairly large, composed of 3 separate sclerites, lateral sclerite with articulating condyle. Distal part of maxilla antenniferous. Stipes parallel-sided and fairly short, mesally closed, with distal membranous area. Peg-like galea inserted on large and elongated palpifer. Palpifer inserted anteriorly on stipes. Palp 3-segmented. Palpomere I moderately elongated, II distinctly shorter, III very small.

Maxillary musculature (figs. 18, 22). – M 15: M. craniocardinalis, O: ventrally from head capsule, posterior to posterior tentorial grooves, I: condyle of lateral cardinal sclerite by means of a tendon; M 17: M. tentorioscapalis, O: posterior tentorial arm, I: mesal sclerite of cardo; M 18a: M. tentorioscapalis, O: posterior tentorial arm, I: mesally on stipital base; M 18b: M. craniostipitalis, O: ventrally from head capsule, posterior to M 15, I: dorsally on stipital base; M 20: M. stipitolacinalis: absent; M 22: M. stipitopalpalis externus: absent; M 23: M. stipitopalpalis internus, O: ventromesally from stipital base, I: laterally on base of palpifer.

### Labium (fig. 9)

Submentum represented by area anterior to posterior tentorial grooves. Not separated from remaining ventral parts of head capsule by a suture. Mentum sclerotized, parallel-sided and narrow, connected with submental area by a membrane. Prementum short and very narrow, distinctly incised anteromedially. Palp slender, 2-segmented. Ligula absent.

Musculature (figs. 18, 22). – M. 28: M. submento-praementalis, O: hind margin of submental area; I: ventromesally on base of mentum; it is likely to assume that the insertion of this muscle has secondarily shifted from the prementum to the mentum; M 29:



Figs. 7-12. Head, ventral view. — 7, *Spercheus emarginatus*; 8, *Hydrochus elongatus*; 9, *Helophorus* sp.; 10, *Berosus* sp.; 11, *Hister* sp.; 12, *Hololepta inaequalis*. Abbreviations: c, cardo, fm, maxillary groove, ga, galea, gu, gula, lbr, labrum, lc, lacinia, md, mandible, mt, mentum, pf, palpifer, pmt, praementum, pmtm, praementommentum, ptg, posterior tentorial groove, smt, submentum, st, stipes, ste, stemma,

M. tentoriopraementalis inferior, O: base of posterior tentorial arm, I: broadly attached to ventral base of prementum; M 30: M. tentoriopraementalis superior: absent; M 34: Mm. praementopalpalis ext.: not identified.

Transverse muscle: connects internal apodemes which originate from posterior mental margin.

### Epipharynx (figs. 14, 22)

Anteriormost part of preoral cavity open laterally. Anterior epipharynx covered with short spines. Posterior part semimembranous, laterally fused with the posterior hypopharynx thus forming a narrow, elongated prepharyngeal tube.

Musculature (figs. 14, 22). – M 43: M. clypeopalatalis, composed of two subcomponents; M 43a, O: anteromedian frontoclypeal region, I: anterior epipharynx; M 43b: composed of four bundles, O: lateral to M 43a, I: successively attached to epipharynx, separated by transverse muscle bands.

### Hypopharynx (fig. 22)

Anterior hypopharynx semimembranous, bulging, distinctly separated from dorsal premental surface by a fold. Dorsal surface covered with short spines. Posterior part of hypopharynx sclerotized, laterally fused with posterior epipharynx, thus forming an elongate, closed prepharyngeal tube.

Musculature (fig. 22). – M 41: M. frontohypopharyngalis, composed of 2 bundles; M 41a, O: frontoclypeal region, posterolateral to M. 45, I: posterolaterally on hypopharynx; M 41b, a strong and flat muscle, O: posterior frontoclypeal region, I: posterolaterally on hypopharynx; M 42m: M. tentorihypopharyngalis medialis, not identified in *H. aequalis*, absent in larvae of *H. redtenbacheri*; M 42l: M. tentorihypopharyngalis lateralis, composed of 2 subcomponents; M 42l<sub>1</sub>, numerous thin fibrillae, O: mesal side of thin, upper part of posterior tentorial arm, I: posterolateral margin of the hypopharynx; M 42l<sub>2</sub>, two short, strong bundles, O: lateral side of upper part of posterior tentorial arm, I: ventrolaterally on posterior hypopharynx.

### Pharynx (fig. 22)

Moderately wide. Ventrolateral and lateral folds present anteriorly, obsolete in posterior part of pharynx.

Musculature (fig. 22). – M 45: M. frontobuccalis anterior, composed of 2 bundles, O: frons, posterior to M 43d; I: dorsolaterally on pharynx, immediately posterior to frontal ganglion; M 46: M. frontobuccalis posterior, a fairly strong, broad and flat muscle, O: posteriormost frontal area, I: dorsolaterally on pharynx; M 51: M. verticopharyngalis: absent; M 52: M. tentoriopharyngalis, fairly strong muscle, O: ventrolaterally from postoccipital ridge, I: ventrolaterally on posterior pharynx.

A well developed ring musculature is present over the whole length of the pharynx.

### Cerebrum and suboesophageal ganglion (fig. 22)

Cerebrum fairly small, strongly shifted posteriorly, only anteriormost part reaches posterior margin of head capsule. Suboesophageal ganglion located in prothorax.

### Glands

Absent.

### Proventriculus

Absent.

### *Hister* sp. (probably final instar)

#### Head capsule, external features (figs. 5, 11)

Head hyperprognathous, broad, parallel-sided, wedge-shaped in lateral view. Cuticle thick, sclerotized parts dark brown or almost black. Distinctly impressed, oblique cervical ridge and curved row of setae present posterolaterally. Distribution of other setae as in figs. 5 and 11. Labrum completely fused, anterior margin of head capsule with rounded adnasalia and an asymmetric arrangement of nasal teeth (fig. 5). Clypeofrontal suture completely absent. Anterior tentorial grooves visible as a fissure posterior to the antennal base. Frons strongly extended posteriorly. Frontal suture very faintly impressed, obliterated posteriorly. Coronal suture absent. One small, completely flattened stemma present posterior to antennal base. Maxillary groove and maxillary articulating membrane completely absent. Posterior tentorial grooves completely fused, shifted to anteromedian region of head capsule. Gula represented by single median suture (ventral ecdysial line).

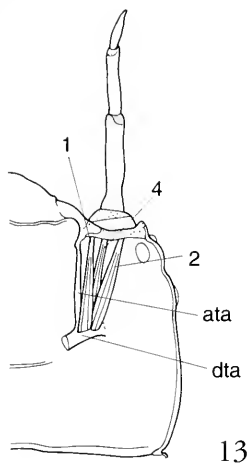
#### Internal skeletal structures (figs. 15, 19, 23)

Posterior tentorial arms proximally fused, strongly shifted cranially, not connected with very extensive postoccipital ridge. Basal part sclerotized and fairly broad, upper part thin and transparent. Tentorial bridge interrupted, represented by narrow, elongated, semimembranous process. Anterior arms strongly developed cranially, arise from fissure-shaped anterior grooves. Dorsal arms arise from anterior arms as flat, apodeme-like structures. Broadly attached to dorsal wall of head capsule close to antennal articulation area. Anterior and dorsal arms connected with posterior arms by very thin unsclerotized cuticle.

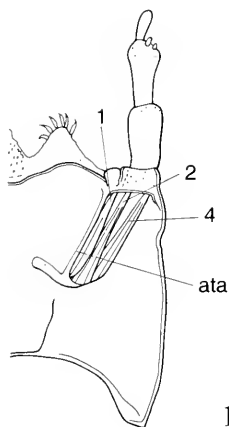
#### Labrum (figs. 5, 23)

Completely fused with clypeofrons, with irregular, asymmetrical nasal teeth, and rather shallow adnasalia set with long, thin hairs.

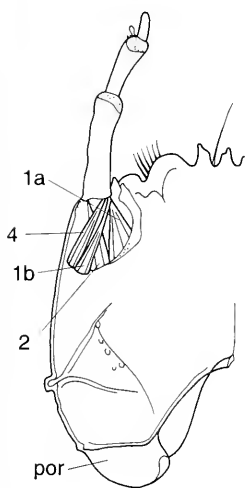
Musculature (fig. 23). – absent.



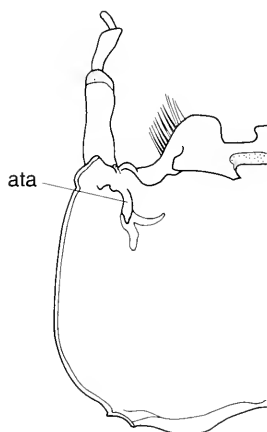
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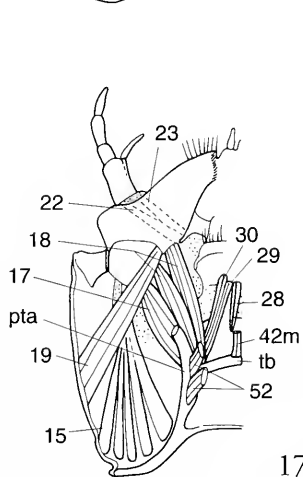
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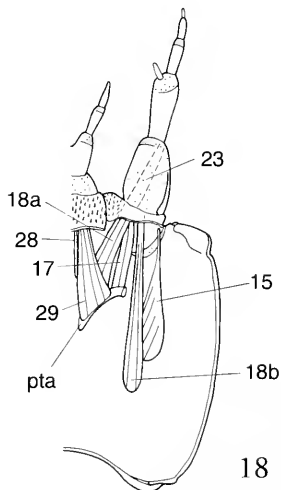
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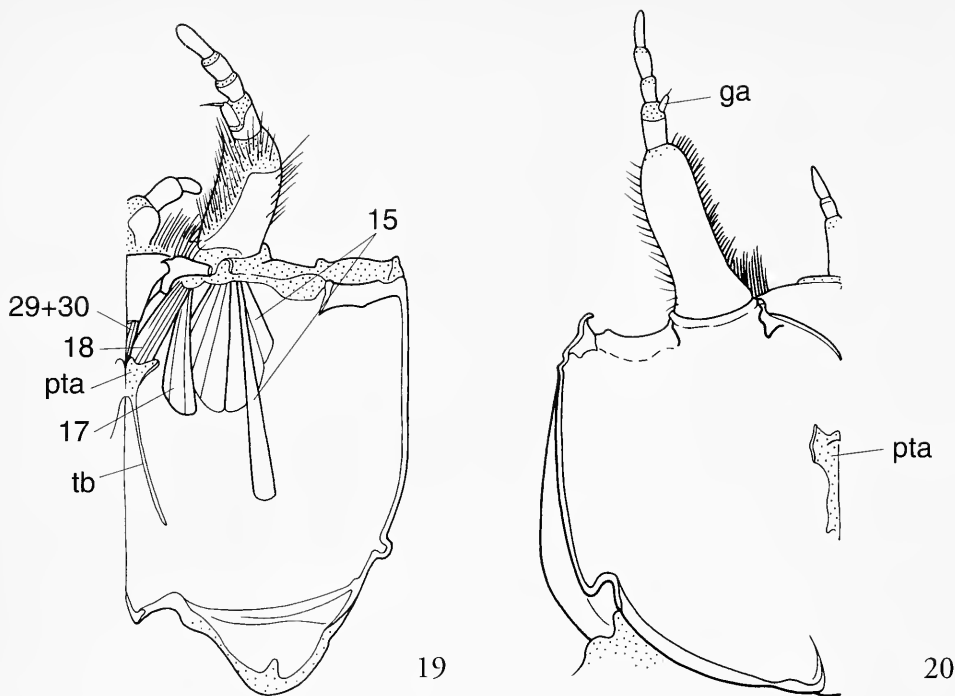


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Figs. 13-18. 13-16. Head, horizontal section, dorsal part. — 13, *Spercheus emarginatus*; 14, *Helophorus* sp.; 15, *Hister* sp.; 16, *Hololepta inaequalis*. — 17-18. head, horizontal section, ventral part; 17, *S. emarginatus*; 18, *Helophorus* sp. Abbreviations: ata, anterior tentorial arm, dta, dorsal tentorial arm, por, postoccipital ridge, pta, posterior tentorial arm, tb, tent. bridge, tm, transverse muscle, 1, M. tentorioscapalis anterior, 2, M. tentorioscapalis posterior, 4, M. tentorioscapalis med., 15, M. craniocardinalis externus, 17, M. craniocardinalis internus, 18, M. tentorioscapalis posterior, 19, M. craniolacinialis, 22, M. stipitopalpalis externus, 23, M. stipitopalpalis internus, 28, M. submentopraementalis, 29, M. tentoriopraementalis inferior, 30, M. tentoriopraementalis superior, 34, M. praementopalpalis, 42m, M. tentoriopharyngalis medialis, 52, M. tentoriopharyngalis.



Figs. 19-20. Head, horizontal section, ventral part. – 19, *Hister* sp.; 20, *Hololepta inaequalis*. Abbreviations: ga, galea, pta, posterior tentorial arm, tb, tent. bridge, 15, M. craniocardinalis externus, 17, M. tentoriocardinalis, 18, M. tentoriostipitalis, 28, M. submentopraementalis, 29, M. tentoriopraementalis inferior.

### Antenna (figs. 5, 15)

3-segmented, inserted anterolaterally, anteriorly directed. Antennomere I strongly elongated. Antennomere II about 2/3 as long as I, with short, hyaline, spindle-shaped sensorial appendage and 2 additional very small sensilla. Antennomere III slender and distinctly shorter than segments I and II.

Musculature (fig. 15). – M 1: M. tentorioscapalis anterior, composed of 2 components; M 1a, O: anterior tentorial arm and apodeme-like dorsal tentorial arm, I: mesally on base of antennomere I by means of a tendon; M 1b, O: head capsule, I: mesally on base of antennomere I by means of a tendon; M 2: M. tentorioscapalis posterior, O: head capsule, between Mm 1a and 1b, I: posterodorsally on antennal base; M 4: M. tentorioscapalis medialis, O: head capsule, lateral to M 1b, I: dorsolaterally on base of antennomere I.

### Mandible (fig. 5)

Falcate, with elongated, pointed distal part and a fairly small, triangular retinaculum. Mola, prosthema, and additional distal teeth absent. Proximal mesal margin with distinct penicillum. Adductor apodeme

flat and unusually extensive.

Musculature (fig. 23). – M 11: M. craniomandibularis internus, extremely strong muscle, O: postoccipital apodeme and extensive parts of the dorsolateral, lateral, ventrolateral, and posteroventral areas of the head capsule, I: adductor tendon; M 12: M. craniomandibularis externus, O: lateral wall of the head capsule, I: abductor tendon.

### Maxilla (figs. 5, 19)

Maxillary groove and articulating membrane absent. Cardio absent or completely fused with stipes. Stipes mesally closed, tube-like, parallel-sided, moderately long. Mesal and distal membranous areas densely set with long hairs. Lateral margin with a row of setae. Palpifer inserted anteriorly on stipes, with mesally attached peg-like galea with distinct apical spine. Palp 3-segmented, palpomeres I and II short, palpomere III moderately elongated, rounded apically.

Maxillary musculature (fig. 19). – M 15: M. craniocardinalis, composed of two components; M 15a, flat fan-like muscle, O: ventrally from head capsule, lateral to posterior tentorial grooves, I: lateral maxil-

lary base; M 15b, long and fairly thin muscle, O: ventrally from head capsule, posterior to M 15a, I: laterally on maxillary base, together with M 15a; M 17: M. tentoriocardinalis, O: submentum, mesally to M. 15b, I: mesally on maxillary base; M 18: M. tentoriostipitalis, O: posterior tentorial arm, I: mesally on maxillary base; M 20: M. stipitolacinalis: absent; M 22: M. stipitopalpalis externus, O: dorsally from stipes, I: laterally on base of palpomere I; M 23: M. stipitopalpalis internus, O: ventrolaterally from stipes, I: ventrally on base of palpomere I.

### Labium (fig. 11)

Submentum completely fused with ventral wall of head capsule. Represented by triangular area anterior to posterior tentorial grooves, laterally delimited by a shallow internal ridge. Mentum completely membranous, semicircular, inserted between submentum and prementum. Prementum short and narrow, incised anteromedially. Palp 2-segmented. Palpomeres fairly short, palpomere II apically rounded. Ligula absent.

Musculature (figs. 19, 32). – M 28a: M. submentopraementalis: absent; M 28b: M. submentomentalis, O: base of posterior tentorial arms, I: ventromesally on base of membranous mentum; M 29, M 30: Mm. tentoriopraementalis inferior and superior, 2 closely adjacent, parallel, longitudinal bundles, O: base of posterior tentorial arm, I: ventrolaterally and laterally on base of prementum; M 34: Mm. praementopalpalis ext.: not identified.

### Epipharynx (figs. 15, 23)

Anteriormost part of preoral cavity open laterally. Anterior epipharynx sclerotized, smooth, without hairs or spines. Posterior part semimembranous, laterally fused with posterior pharynx thus forming a very narrow, elongate prepharyngeal tube.

Musculature (fig. 23). – M 43: M. clypeopalatalis, composed of four strong subcomponents; M 43a, O: anterior clypeal region, close to median line, I: anterior epipharynx; M 43b, O: posteromesal to M 43a, I: posterior to M 43a; M 43c, composed of four bundles which are separated by transverse muscle bands, O: posterior clypeal area, posterolateral to M 43b, I: posterior epipharynx; M 43d, O: posterior clypeal area, lateral to M 43d, I: lateral to M 43d.

### Hypopharynx (fig. 23)

Anterior hypopharynx flat and strongly sclerotized except for anterior margin, with a dense field of long hairs anterolaterally. Laterally connected with strongly sclerotized bar between maxilla and mandible. Posterior part sclerotized, narrow, laterally fused with posterior epipharynx.

Musculature (fig. 23). – M 41: M. frontohypopharyngalis, a very flat muscle, O: frons, immediately

lateral to M. 45, I: posterolaterally on hypopharynx; M 42m: M. tentorihypopharyngalis medialis: absent; M 42l: M. tentorihypopharyngalis lateralis: absent

### Pharynx (fig. 23)

Distinctly narrowed.

Musculature (fig. 23). – M 45: M. frontobuccalis anterior, a flat muscle, O: frons, mesal to M 41, I: dorsolaterally on pharynx, immediately posterior to frontal ganglion. M 46: M. frontobuccalis posterior, composed of 4 bundles which are separated by ring muscles, O: posteriormost frontal area, I: dorsolaterally on pharynx; M 51: M. verticopharyngalis, absent; M 52: M. tentorihypopharyngalis: absent.

A well developed ring musculature is present over the whole length of the pharynx.

### Cerebrum and suboesophageal ganglion (fig. 23)

Cerebrum and suboesophageal ganglion completely shifted to prothorax.

### Glands

Absent.

### Proventriculus

Absent.

### LIST OF CHARACTERS

For the character state matrix see table 1.

1. – Head: (0) subprognathous; (1) prognathous; (2) hyperprognathous; (3) orthognathous.

An orthognathous position of mouthparts is characteristic for larvae of Scarabaeoidea (Carlson 1991) whereas a moderately inclined head and a subprognathous position of mouthparts is found in larvae of Hydraenidae, Agyrtidae, and Spercheidae (fig. 21). The head is distinctly prognathous in larvae of Hydrochidae (fig. 2), Helophoridae (fig. 22), Georissidae, Epimetopidae (Richmond 1920, Costa et al. 1988), and Histeroidea (part.; Newton 1991). A hyperprognathous position is characteristic for some larvae of Histeridae (fig. 23) and for larvae of Hydrophilidae (Richmond 1920, Böving & Henriksen 1938, Bertrand 1972, Archangelsky 1997).

2. – Labrum and clypeus: (0) connected by a membrane; (1) labrum and clypeus fused (figs. 1-6).

A free labrum is found in larvae of Hydraenidae, Agyrtidae, Scarabaeoidea (Carlson 1991), and many other polyphagan larvae. Labrum and clypeus are fused in larvae of Hydrophiloidea (sensu Hansen 1991; figs. 1-6; Richmond 1920, Costa et al. 1988) and Histeroidea (figs. 5-6; Newton 1991). An indistinct transverse impression is present in larvae of

*Spercheus emarginatus* (fig. 1). However, it is not clear whether this is a remnant of a clypeolabral suture.

3. – Clypeofrontal suture: (0) present; (1) absent (figs. 1-6).

4. – Anterior clypeolabral margin: (0) nasale and adnasalia absent or very indistinct, without mesally directed setae or spines; (1) nasale present, adnasalia distinct, with mesally directed setae or spines (see also Archangelsky 1998; coding modified).

Nasale and adnasalia with mesally directed setae or spines are present in larvae of Helophoridae, Georissidae, Epimetopidae, most Hydrophilidae (figs. 3, 4; v. Emden 1956, Richmond 1920, Böving & Henriksen 1938), and in the histerid larvae examined (figs. 5, 6). Adnasalia are extremely indistinct and the nasale is absent in larvae of *Derallus* (Spangler 1966; coded as 0&1 for Berosini). Both structures are completely absent from larvae of Spercheidae (fig. 1). A reduced nasale is present in larvae of *Hydrochus rufipes* (Archangelksy 1997), but only a shallow anteromedian concavity of the clypeolabral margin was found in the hydrochid larvae examined (angle of mesal edge about 20°). Mesally directed setae or spines are absent (fig. 2; Richmond 1920). This condition is clearly different from what is found in most other hydrophiloid larvae (excluding Spercheidae).

5. – Armature of anterolateral clypeolabral margin: (0) without setae, long hairs or fixed spines; (1) adnasalia with moderately long setae; (2) with long and thin hairs; (3) with fixed cuticular spines.

Fixed cuticular spines are present on the mesal edges of the adnasalia in larvae of Georissidae (v. Emden 1956) and Epimetopidae (Costa et al. 1988). Similar structures are not found in other larvae of Hydrophiloidea. The adnasalia are set with mesally directed setae in larvae of Helophoridae (fig. 3), and Hydrophilidae (fig. 4). Long and thin hairs are present in larvae of Sphaeritidae (Nikitsky 1976), Synteliidae (Newton 1991; fig. 34.306), and Histeridae (figs. 5-6).

6. – Gula: (0) short and broad; (1) elongate and strongly narrowed gula or gula suture.

A short and broad gula is present in larvae of Hydraenidae, Scarabaeoidea (Carlson 1991), Spercheidae (fig. 7), and Hydrochidae (fig. 8; Richmond 1920). The rectangular gula is fairly small in larvae of the latter family. The gula is narrow and elongated in other larvae of Hydrophiloidea and Histeroidea (sutures still separated in larvae of Sphaeritidae; Nikitsky 1976; very indistinct in Histeridae).

7. – Posterior tentorial arms: (0) origin immediately anterior to hind margin of head capsule; (1) origi-

nate from central part of head capsule.

The posterior tentorial arms arise immediately anterior to the hind margin of the head capsule in larvae of Spercheidae and Hydrochidae (figs. 7, 8). They originate in the anteromedian region of the head capsule in other larvae of Hydrophiloidea and Histeroidea (figs. 9-12; Beutel 1994, Richmond 1920, Lawrence 1991, Newton 1991).

8. – Tentorial bridge: (0) straight and fairly broad; (1) thin and U-shaped; (2) interrupted or absent (figs. 18-20).

A straight and well developed, sclerotized tentorial bridge which arises from the posterior tentorial arms close to the foramen occipitale is present in larvae of Scarabaeidae, Hydraenidae, and Spercheidae (fig. 17). A thin and U- or V-shaped tentorial bridge is found in larvae of Hydrophilinae (pers. obs.; Moulins 1959). It is completely reduced in larvae of Helophoridae and larvae of Sphaeridiinae examined by Quennedey (1965), and very thin and interrupted in the histerid larvae examined.

9. – Antenna: (0) anterolaterally directed; (1) anteriorly directed (figs. 1-6).

The antennae of larvae of Scarabaeidae, Agyrtidae, and Hydraenidae are directed anterolaterally. The articulating area is oblique. An anterior orientation of the antenna and a transverse articulating area is characteristic for larvae of Histeroidea and Hydrophiloidea (figs. 1-6; Richmond 1920, Böving & Henriksen 1938, Quennedey 1965, Newton 1991).

10. – Antennal insertion: (0) anterolaterally; (1) on dorsal side of head capsule (fig. 4).

The antennae are distinctly shifted mesally in larvae of Hydrophilidae (fig. 4; Richmond 1920, Böving & Henriksen 1938, Quennedey 1965, Costa et al. 1988, Archangelsky 1997). They are inserted anterolaterally in other hydrophiloid and histeroid larvae examined (figs. 1-3, 5-6; Costa et al. 1988, Newton 1991), and also in larvae of Scarabaeidae, Agyrtidae, and Hydraenidae. Mesally shifted larval antennae are also characteristic for larvae of Paederinae and Staphylininae (Beutel & Molenda 1997).

11. – Origin of antennal muscles: (0) anterior tentorial arms; (1) anterior arms, dorsal arms, and head capsule (fig. 15); (2) dorsal tentorial arms (figs. 13, 14); (3) head capsule.

The antennal muscles arise from the head capsule in larvae of Scarabaeidae (pers. obs.; Crome 1957), from the anterior tentorial arms in larvae of Hydraenidae, and from the dorsal arms in larvae of *Spercheus* (fig. 13), *Helophorus* (fig. 14), and Hydrophilinae (pers. obs.; Moulins 1959). They originate from the



anterior arms, the flattened dorsal arms, and the head capsule in the larvae of Histeridae examined (fig. 15).

12. – Mandibular mola: (0) present; (1) absent; (2) pseudomola.

A conspicuous pseudomola is present at the mesal margin of the mandibular base of hydrochid larvae (fig. 2). It is structurally and functionally clearly different from a true mola. Different pseudomolar areas are also present on one or both mandibles of sphaeridiine larvae (Quennedey 1965). The mandibles are quite variable in this subfamily. Strongly asymmetric mandibles are present in many larvae of Sphaeridiinae, but not in *Coelostoma orbiculare* F. and others (Böving & Henriksen 1938; Archangelsky, pers. comm.).

13. – Mandibular prostheca: (0) present; (1) absent (figs. 2-6).

A mandibular prostheca is present in larvae of Hydraenidae and Agyrtidae (Newton 1991) but absent from all other larvae examined (Richmond 1920, Costa et al. 1988, Lawrence 1991, Newton 1991).

14. – Retinaculum: (0) absent; (1) simple; (2) strongly developed, bidentate.

A more or less strong, simple retinaculum is present in larvae of Spercheidae and Histeroidea (figs. 5, 6; Newton 1991). A strong, double retinaculum is characteristic for larvae of Helophoridae (fig. 3), Georissidae (v. Emden 1956), Epimetopidae (Costa et al. 1988), and most larvae of Hydrophilinae (Richmond 1920, Böving & Henriksen 1938, Costa et al. 1988; asymmetric in *Berosus*). It is strongly modified or absent in most larvae of Sphaeridiinae, but the typical bidentate condition is found in larvae of *Coelostoma orbiculare* F. and *Dactylosternum subrotundum* (Fabricius, 1772) (Costa et al. 1988, Böving & Henriksen 1938). A bidentate retinaculum was not observed in the hydrochid larvae available for this study (fig. 2).

15. – Penicillus: (0) absent; (1) present.

A mandibular penicillus is absent from larvae of Hydraenidae, Agyrtidae, Scarabaeidae, Spercheidae (fig. 1), Hydrochidae (fig. 2), and Hydrophilidae (fig. 4; Archangelsky 1998). It is present in larvae of Histeroidea (Newton 1991), and in larvae of Helophoridae (fig. 3; Böving & Henriksen 1938). An elongated row of hairs is found on the proximomesal margin of the mandible of larvae of Epimetopidae (Costa et al. 1988).

16. – M. craniomandibularis: (0) origin laterally and dorsolaterally; (1) extremely strong, with ventrally extended area of origin (figs. 22, 23, 27).

M. craniomandibularis is extremely strong in the prognathous larvae of Helophoridae (fig. 26) and Hydrophilidae (pers. obs.; Moulins 1959), and in the larvae of Histeridae examined (figs. 23, 27). The attachment area is strongly extended ventrally in correlation with the narrowing of the gular area. The muscle is less strongly developed in larvae of Hydraenidae (part.), Agyrtidae (Beutel & Molenda 1997), Scarabaeoidea (part., Carlson 1991, fig. 34.326), Spercheidae (fig. 25), and Hydrochidae (*H. megaphallus*). The area of origin is largely restricted to the lateral and dorsolateral area of the head capsule.

17. – Maxillary groove: (0) deep, with well developed articulating membrane; (1) maxillary groove partly reduced; (2) maxillary groove absent.

A deep maxillary groove and a well developed articulating membrane is present in larvae of Spercheidae (fig. 7) and Hydrochidae (fig. 8). The maxillary groove is distinctly reduced in larvae of the remaining groups of Hydrophiloidea (fig. 10; Richmond 1920, Böving & Henriksen 1938). The maxillary groove is completely absent from larvae of Histeroidea (figs. 11, 12; Nikitsky 1976, Newton 1991).

18. – Moveability between cardo and stipes: (0) not restricted; (1) largely restricted; (2) no intramaxillary moveability, cardo fused with stipes or completely reduced.

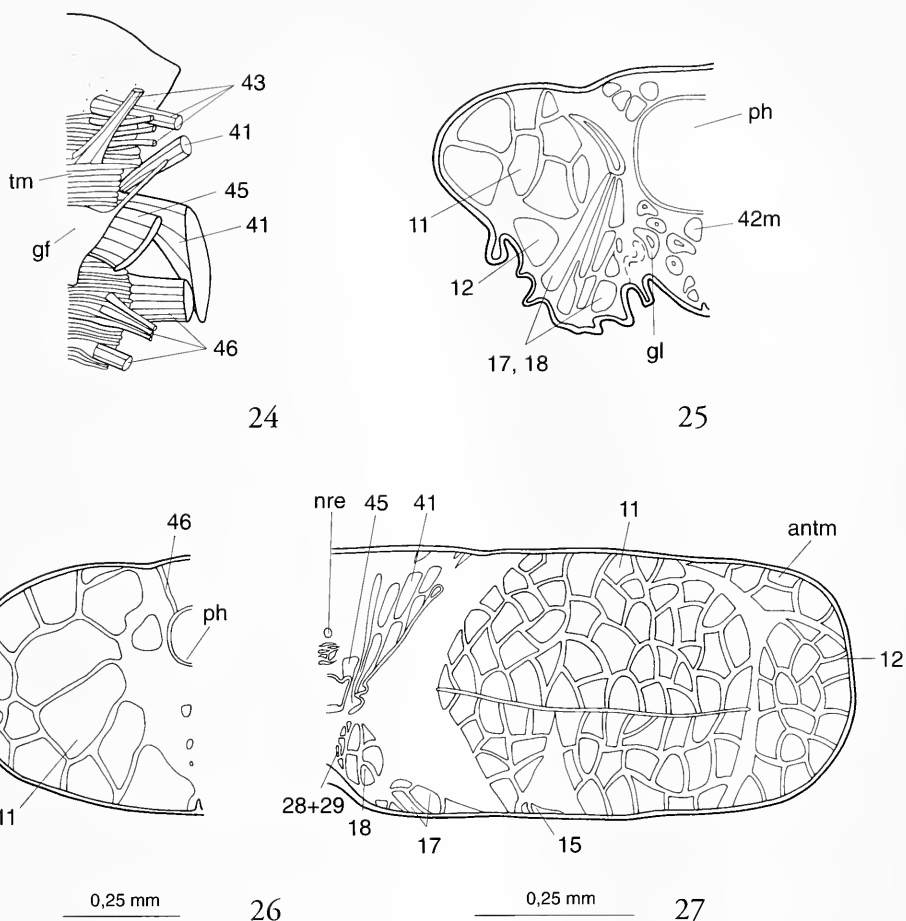
The moveability between cardo and stipes is fully retained in larvae of Spercheidae (fig. 7) and in many other larvae of Polyphaga (e.g. Hydraenidae, Leiodidae, Scarabaeidae; Beutel & Molenda 1997, Crome 1957). It is largely restricted in larvae of Hydrochidae, Helophoridae (fig. 9), Georissidae, and Hydrophilinae (fig. 10). The intramaxillary moveability is completely reduced in larvae of Histeroidea (figs. 11, 12; Newton 1991).

19. – Cardo: (0) undivided; (1) divided; (2) not present as a separate sclerite.

The cardo is divided into several sclerites in larvae of all hydrophiloid groups (Archangelsky 1997, 1998; pers. obs.) with the exception of Spercheidae (fig. 7). A cardo is not present as a separate sclerite in larvae of Histeroidea (Newton 1991).

20. – Stipes: (0) mesally open proximally; (1) mesally closed.

The stipes is mesally closed and tube-like in larvae of Histeroidea and Hydrophiloidea (excluding Spercheidae) (figs. 8-12, 18-20, 22, 23; Newton 1991). The proximal part of the stipes is mesally connected with the lumen of the head capsule in larvae of *Spercheus*. It is roughly semicircular in cross section, thus allowing the attachment of M. 18 on the ventral



Figs. 24-27. 24. Pharynx and prepharynx, *Spercheus emarginatus*. 25. Cross section, pharyngeal region, *S. emarginatus*. 26. Cross section, pharyngeal region, *Helophorus* sp.; 27. Cross section, anterior pharyngeal region, *Hololepta aequalis*. Abbreviations: antm, antennal muscles, gf, ganglion frontale, gl, gland, nre, nervus recurrens, ph, pharynx, tm, transverse muscle, 11, M. craniomandibularis internus, 12, M. craniomandibularis externus, 15, M. craniocardinalis externus, 17, M. tentoriocardinalis, 18, M. tentoriostipitalis, 28, M. submentopraementalis, 29, M. tentoriopraementalis inferior, 30, M. tentoriopraementalis superior, 41, M. frontohypopharyngalis, 42 m, M. tentorihypopharyngalis medialis, 43, M. clypeopalatalis, 45, M. frontobuccalis anterior, 46, M. frontobuccalis posterior.

stipital surface (fig. 17). The same condition is found in larvae of Hydraenidae, Leioididae and many others (Beutel & Molenda 1997: figs. 7, 9).

21. – Lacinia: (0) strongly developed, hook-like (figs. 7, 17); (1) small mesal protuberance; (2) absent (figs. 8-12).

A strongly developed hook-like lacinia is present in larvae of Hydraenidae, Agyrtidae Scarabaeoidea (Carlson 1991), and Spercheidae (fig. 7). It is absent from some larvae of Hydrochidae (figs. 2, 8) and

from other larvae of Hydrophiloidea and Histeroidea (Lawrence 1991). A small mesal protuberance is present in hydrochid larvae described by Archangelsky (1997) and Richmond (1920). This condition is clearly different from the lacinia found in spercheid larvae and should not be coded as the same character state (see Archangelsky 1998).

22. – Palpifer: (0) laterally inserted on stipes; (1)

anteriorly inserted on stipes.

The palp is inserted laterally on the stipes in larvae of Spercheidae (figs. 7, 17). It is inserted anteriorly in larvae of Histeroidea and larvae of other hydrophiloid families. Stipes and palp together form an antenna-like structure (figs. 8, 9-12, 18).

23. – Insertion of galea: (0) outer side of lacinia; (1) palpomere I (figs. 9-12); (2) galea absent or reduced to a small non-articulated process.

The galea is inserted on the outer side of the lacinia in larvae of Hydraenidae, Agyrtidae, and Scarabaeidae. It is shifted to the mesal side of the palpomere I of larvae of Histeroidea and Hydrophiloidea (figs. 7-10; Richmond 1920, Costa et al. 1988, Lawrence 1991, Newton 1991). The galea is absent from the maxilla of larvae of Hydrochidae examined. A non-articulated inner process, which is present in larvae of *Hydrochus rufipes* (Archangelsky 1997), is not considered as a true outer lobe of the maxilla in this study (coded as 2).

24. – Mm. tentoriocardinalis and -stipitalis (Mm. 17, 18): (0) attached to ventral surface of cardo and stipes, almost vertical orientation (figs. 17, 25); (1) mesally attached to cardinal and stipital base, longitudinal orientation (figs. 18, 19).

An oblique, almost vertical arrangement of the tentoriocardinal and -stipital muscles is found in larvae of Hydraenidae, Scarabaeidae, Agyrtidae (Beutel & Molenda 1997), and Spercheidae (fig. 25). The muscles are composed of several strong bundles and attached to the ventral surface of the cardo and stipes respectively. Fairly thin Mm. tentoriocardinalis- and -stipitalis are longitudinally arranged in larvae of Histeridae (fig. 19, 27) and Hydrophiloidea (excluding Spercheidae; fig. 18).

25. – M. craniolacinalis (M. 19): (0) present (fig. 17); (1) absent (figs. 18, 19).

A craniolacinal muscle (M 19) which originates from the lateral wall of the head capsule is present in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeidae, and Spercheidae (fig. 17). It is inserted on the posteromesal margin of the lacinia. A muscle with the same origin and insertion is not found in other larvae under consideration (figs. 18, 19; Das 1937, Moulins 1959).

26. – M. craniostipitalis (M. 18b): (0) present; (1) absent

M. craniostipitalis (M 18b) originates from the ventral wall of the head capsule and is dorsally attached to the stipital base. It is present in Hydrophiloidea excluding Spercheidae and Hydrochidae (figs. 17, 18). Considering the character distribution it appears quite likely that this muscle is

derived from M. craniolacinalis (see Beutel 1993). However, the function is clearly different. M 19 is an adductor of the lacinia whereas M 18b acts as a levator of the maxilla. Homology between the posterior component of M craniocardinalis (M 15) in Histeridae and M 19 cannot be fully excluded, even though the attachment is identical with the broad anterior portion of M 15.

27. – Stipitopalpal muscles: (0) two (fig. 17); (1) one (fig. 18).

Two antagonistic stipitopalpal muscles are present in the histerid larvae examined (fig. 19) and in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeidae, and Spercheidae (fig. 17). One muscle is present in larvae of *Helophorus* (fig. 18) and Hydrophilidae (Das 1937, Moulins 1959; pers. obs.).

28. – Mentum: (0) distinct, inserted between maxillary grooves; (1) sclerotized, fairly large, shifted anteriorly; (2) mentum small, absent or completely membranous; (3) fused with prementum.

The mentum is inserted between the maxillary grooves in larvae of Scarabaeidae, Agyrtidae (Newton 1991, Beutel & Molenda 1997), Hydraenidae (Beutel & Molenda 1997), Spercheidae (fused with prementum; fig. 7), and Hydrochidae (fig. 8). It is well developed, sclerotized, and shifted to the anterior margin of the head capsule in larvae of Helophoridae, Epimetopidae, Georissidae, Sphaeridiinae, and Hydrophilinae (figs. 9, 10; Richmond 1920, Böving & Craighead 1931, Costa et al. 1988, Archangelsky 1998). The mentum is fairly small and completely membranous in larvae of Histeroidea (figs. 11, 12; pers. obs.; Newton 1991).

29. – Submentum: (0) enclosed by maxillary articulating membrane; (1) integrated in the sclerotized ventral wall of the head capsule.

The submentum is laterally enclosed by the maxillary articulating membrane in larvae of Hydraenidae, Agyrtidae, Scarabaeidae, Spercheidae (fig. 7; Beutel & Molenda 1997), and in contrast to Archangelsky (1998, char. 32) also in larvae of Hydrochidae (fig. 8). It is firmly integrated in the ventral wall of the head capsule in larvae of Histeroidea (figs. 11, 12; Newton 1991), Helophoridae (fig. 9), Epimetopidae (Costa et al. 1988), Georissidae (v. Emden 1956), and Hydrophilidae (Richmond 1920, Böving & Henriksen 1938, Moulins 1959, Quennedey 1965).

30. – Submental suture: (0) absent; (1) present.

A distinct V-shaped or almost straight suture is present in larvae of Epimetopidae (Costa et al. 1988: Pl. 23, fig. 4), Georissidae (pers. obs.; v. Emden 1956), and Hydrophilidae (fig. 10; Richmond 1920, Böving & Henriksen 1938, Moulins 1959, Quennedey 1965).

31. – Origin of *M. tentoriopraementalis* inferior: (0) posterior tentorial arms; (1) median submental apodeme.

*M. tentoriopraementalis* inferior arises from the posterior tentorial arms in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeidae, *Spercheus* (fig. 17), *Helophorus* (fig. 18), and in the larvae of Histeridae examined (fig. 19). It originates from the posterior margin of the submental sclerite in larvae of Hydrophilidae (pers. obs.; Dorsey 1943, Moulins 1959). The origin in larvae of Epimetopidae and Georissidae is unclear.

32. – *M. tentoriohypopharyngalis medialis* (M. 42): (0) present (fig. 21); (1) absent (figs. 22–23).

*M. tentoriohypopharyngalis medialis* is present in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), *Spercheus* (fig. 21), *Helophorus* (fig. 22), and Hydrophilinae (Moulins 1959). It is absent from the larvae of Histeridae examined (fig. 23).

33. – Dense preoral filter apparatus: (0) absent; (1) present.

A dense preoral filter apparatus is absent from larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeoidea (Carlson 1991), Spercheidae (fig. 21), Hydrochidae, Helophoridae (fig. 22), Epimetopidae, and Hydrophilidae (Richmond 1920, Böving & Henriksen 1938, Moulins 1959, Quennedey 1965, Costa et al. 1988). It is present in larvae of Histeroidea (fig. 23; Newton 1991).

34. – Preoral cavity: (0) open cibarium or short prepharyngeal tube; (1) strongly elongated prepharyngeal tube.

An open cibarium or short prepharyngeal tube (less than 20% of head length) is present in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeidae, and Spercheidae (fig. 21), whereas a distinctly elongated, narrow prepharynx is found in larvae of *Helophorus* (fig. 22), Hydrophilidae (pers. obs.; Quennedey 1965, Moulins 1959), and the histerid larvae examined (fig. 23).

35. – Functional mouth: (0) dilatable; (1) not dilatable.

The functional mouth can be dilated by retraction and depression of the hypopharynx and contraction of *Mm. clypeopalatalis* and frontohypopharyngalis in larvae of Scarabaeidae, Agyrtidae, Hydraenidae (Beutel & Molenda 1997), and Spercheidae (fig. 21). It is not or only very slightly dilatable in larvae of Helophoridae (fig. 22), Sphaeridiinae (Quennedey 1965), Hydrophilinae, and Histeridae (fig. 23).

36. – Pharynx: (0) wide; (1) extremely wide; (2) narrow.

The pharynx is moderately wide in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeidae, and *Helophorus* (figs. 22, 26). It is extremely wide in larvae of Spercheidae (fig. 25) and strongly narrowed in the larvae of Hydrophilidae and Histeridae examined (fig. 27; Quennedey 1965, Moulins 1959).

37. – Posterior pharyngeal pumping apparatus: (0) present; (1) absent.

A well developed posterior pharyngeal pumping apparatus is present in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeidae, Spercheidae (fig. 21), and Helophoridae (fig. 22). It is composed by a strongly developed *M. frontopharyngalis* posterior and tentoriopharyngeal dilators. These muscles are attached to the pharynx dorsolaterally and ventrolaterally. Tentoriopharyngeal dilators are absent from the larvae of Histeridae examined (figs. 23, 27). They are thin and attached to the ventral side of the anterior pharynx in larvae of Hydrophilidae (Moulins 1959). *M. frontopharyngalis* attaches the posterior pharynx to the dorsal wall of the head capsule but is not part of a pumping apparatus. It is unusually flat in larvae of Histeridae.

38. – Cerebrum: (0) located in posterior region of head capsule; (1) shifted to the anterior prothorax.

The cerebrum is located in the posterior region of the head capsule in larvae of Hydraenidae, Agyrtidae (Beutel & Molenda 1997), Scarabaeidae (Crome 1957), and *Spercheus* (fig. 21). It is shifted to the anterior prothoracic region in the larvae of Helophoridae (fig. 22), Hydrophilidae, and Histeridae examined.

39. – Stigmatic atrium: (0) absent; (1) present.

A stigmatic atrium of segment VIII is present in most larvae of Hydrophilidae (Hansen 1991, Böving & Henriksen 1938, Moulins 1959, Quennedey 1965; reduced), and also in larvae of Hydrochidae and Spercheidae (Richmond 1920, Hansen 1991, Archangelsky 1997, 1998). It is absent from larvae of *Berosus* (Böving & Richmond 1938; coded as 0&1 for Berosini) and all other larvae under consideration. A detailed comparative morphological study of the structures involved is wanting at present. Independent evolution in larvae of Hydrochidae was proposed by Hansen (1991).

40. – Tergal shield of abdominal segment VIII: (0) absent; (1) present.

A distinct, sclerotized tergal shield of the abdominal segment VIII is absent from larvae of Hydraenidae, Agyrtidae (Newton 1991), Scarabaeidae, Histeroidea (Newton 1991), Helophoridae, Epimetopidae (Costa et al. 1988), and Georissidae. It is pre-

sent in larvae of *Spercheus*, *Hydrochus* (Richmond 1920, Hansen 1991), and Hydrophilidae.

41. – Eggs: (0) deposited uncovered; (1) eggs covered with silk-like strands or enclosed in egg cases or cocoons.

Eggs are covered with secretions of silk glands or deposited in egg cases or cocoons in most larvae of Hydraenidae (see Hansen 1997b) and in larvae of Hydrophiloidea (Richmond 1920, Spangler 1991, Hansen 1991, 1997a, b). A similar condition is not described for other larvae of Staphyliniformia.

#### ANALYSIS

41 Characters of larvae were analysed (table 1). The outgroup comprises the staphyliniform families Scarabaeidae, Leiodidae, Agyrtidae, and Hydraenidae (Staphyliniformia s. Hansen 1997a). All characters were weighted equally and not ordered.

Most parsimonious trees were sought using branch and bound search in paup (version 3.1; Swofford 1991). The outgroup taxa were treated as all other groups in the analysis (simultaneous analysis; Nixon & Carpenter 1993). Analysis of character evolution was conducted in MacClade (version 3; Maddison and Maddison 1992). Branch support values (Bremer 1988) were calculated using the 'converse approach' (Bremer 1994). They indicate the number of steps which is required to collapse a branch.

#### Results of the analysis

The analysis of larval characters resulted in 33 minimum length trees of 74 steps length (CI = 0.878; RC = 0.819) (unambiguously placed apomorphies fig. 28, strict consensus tree fig. 29). The branching pattern of the ingroup taxa is consistent in all trees with the exception of the histeroid families (strict consensus tree: fig. 29).

Table 1. Character state matrix, larval characters of Hydrophiloidea and Histeroidea.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Scarabaeidae	3	0	0	0	0	0	0	0	0	0	3	0	1	0&1	0	0	0	0	0	0
Leiodidae	0	0	1	0	0	0	0	0	0	0	0	0	0&1	0&1	0	0	0	0	0	0
Agyrtidae	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0&1	0	0	0	0	0	0
Histeridae	1&2	1	1	1	2	1	1	2	1	0	1	1	1	1	1	1	2	2	2	1
Synteliidae	1	1	1	1	2	1	1	?	1	0	?	1	1	1	1	?	2	2	2	1
Sphaeritidae	1	1	1	1	2	1	1	?	1	0	?	1	1	1	1	?	2	2	2	1
Spercheidae	0	1	1	0	0	0	0	0	1	0	2	1	1	1	0	0	0	0	0	0
Hydrochidae	1	1	1	0	0	0	0	?	1	0	?	2	1	1	0	0	0	1	1	1
Helophoridae	1	1	1	1	1	1	1	2	1	0	2	1	1	2	0&1	1	1	1	1	1
Georissidae	1	1	1	1	3	1	1	?	1	0	?	1	1	2	0	?	1	1	1	1
Epimetopidae	1	1	1	1	3	1	1	?	1	0	?	1	1	2	0	?	1	1	1	1
Berosini	2	1	1	0&1	1	1	1	?	1	1	2	1	1	2	0	1	1	1	1	1
Hydrophilini	2	1	1	1	1	1	1	1	1	1	2	1	1	2	0	1	1	1	1	1

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Scarabaeidae	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Leiodidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agyrtidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydraenidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Histeridae	1	1	1	1	1	1	0	2	1	0	0	1	1	1	1	2	1	1	0	0	0
Synteliidae	1	1	1	?	?	?	2	1	0	?	?	1	?	?	?	?	?	?	0	0	0
Sphaeritidae	1	1	1	?	?	?	2	1	0	?	?	1	?	?	?	?	?	?	0	0	0
Spercheidae	0	0	1	0	0	1	0	3	0	0	0	0	0	0	0	1	0	0	1	1	1
Hydrochidae	1	1	2	?	1	?	?	0	0	0	0	?	0	1	?	?	?	?	1	1	1
Helophoridae	1	1	1	1	1	0	1	1	1	0	0	?	0	1	1	0	1	1	0	0	1
Georissidae	1	1	1	?	?	?	?	1	1	1	?	?	0	1	?	?	?	?	0	0	?
Epimetopidae	1	1	1	?	?	?	?	1	1	1	?	?	0	1	?	?	?	?	0	0	1
Berosini	1	1	1	1	1	?	1	1	1	1	1	?	0	1	1	2	1	1	0&1	1	1
Hydrophilini	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	2	1	1	1	1	1

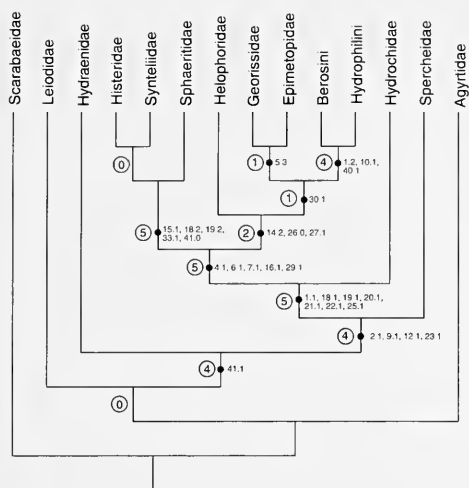


Fig. 28. Preferred of 33 cladograms with 74 steps. Unambiguously placed characters mapped on cladogram; numbers left to branches are decay indices.

## DISCUSSION

Most apomorphic features of larvae of Hydrophiloidea and Histeroidea are apparently related with predation, which is the most widespread feeding habit in this lineage of Staphyliniformia (Hansen 1997b). Fusion of labrum and clypeus, loss of the mandibular mola (and prostheca), and anteriorly directed antennae are derived features which are also commonly found in other groups with predacious larvae such as Adephaga, Paederinae, Staphylininae, Elateroidea (part.), and Cantharoidea (Beutel & Molenda 1997, Beutel 1993, 1995).

Larvae of Spercheidae prey upon dipteran larvae as later instars, but feed at least partly on organic matter on the underside of the water surface (Böving & Henriksen 1938). Enlargement of the prementum, and the presence of regular rows of spines on the edges of mandibles, laciniae, and the prementum margin are probably autapomorphies correlated with this specialized behaviour (fig. 21). Other character states were interpreted as plesiomorphic in the analysis presented above and suggest a basal position of Spercheidae within the hydrophiloid-histeroid lineage. Especially the head capsule is clearly different from what is found in other hydrophiloid larvae. The orientation of the mouthparts is subprognathous. A broad gula is present. The posterior tentorial arms originate close to the hind margin of the head capsule. The tentorial bridge is fairly broad and straight. Adnasalia and nasalia are absent. A deep maxillary groove and an exposed articulating membrane are present. The mentum is not shifted anteriorly but inserted be-

tween the fossae maxillaris. Very similar conditions are found in other staphyliniform larvae such as Hydraenidae, Agyrtidae, and Leiodidae (Beutel & Molenda 1997). Some of these character states are also found (maintained?) in larvae of Hydrochidae (figs. 2, 8; see also data matrix): broad gula, posterior tentorial arms arise close to foramen occipitale, nasale absent, adnasalia very indistinct, deep maxillary grooves, mentum not shifted anteriorly.

A prognathous or hyperprognathous head is found in other hydrophiloid and histeroid larvae. Larvae of Histeroidea + Hydrophiloidea excluding Spercheidae and Hydrochidae are characterized by the following derived features of the head capsule: narrow gular suture, posterior tentorial grooves distinctly shifted anteriorly (central part of head capsule), distinct nasale and adnasalia (fairly shallow in some larvae of Histeroidea; fig. 5), narrow and U-shaped or absent tentorial bridge, partly or completely (figs. 9-12) reduced maxillary grooves, and anteriorly shifted mentum (membranous in larvae of Histeroidea; figs. 11-12).

Nasale and adnasalia are also characteristic for larvae of Carabidae (Beutel 1993), Paederinae, Staphylininae (Beutel & Molenda 1997), and Elateridae (Beutel 1995). These structures may facilitate the capturing of prey and mechanical treatment during preoral digestion (Beutel & Molenda 1997). Interaction between nasale and mandibles were described by Spence & Sutcliffe (1982) for larvae of *Nebria*.

Reduction of the gula and anterior shift of the posterior tentorial arms result in an extended ventrolateral and ventral attachment area of the mandibular adductor muscle. This feature is also found in other groups with predacious larvae such as Gyrinidae, Trachypachidae, Carabidae, Paederinae, and Staphylininae (Beutel & Molenda 1997, Beutel 1993), but not in the predacious subgroups of Elateriformia (Beutel 1995).

Other presumably plesiomorphic features of larvae of Spercheidae are related with the larval maxilla. The cardo is undivided and the moveability between cardo and stipes is fully retained. The orientation of Mm. tentoriocardinalis- and tentoriostipitalis is oblique, almost vertical in cross section (figs. 17, 25). The stipes is mesally open, i.e. broadly connected with the interior of the head capsule. The palp is inserted laterally. The lacinia is strong and hook-like. M. craniolacinalis is present. It originates from the lateral wall of the head capsule and inserts on the base of the lacinia. These conditions are very similar to what is found in larvae of Hydraenidae, Leiodidae, Agyrtidae, and other staphylinoid larvae (Beutel & Molenda 1997).

The cardo is represented by two or more sclerites in other larvae of Hydrophiloidea (excl. Spercheidae; figs. 9-10) and completely fused with the stipes or

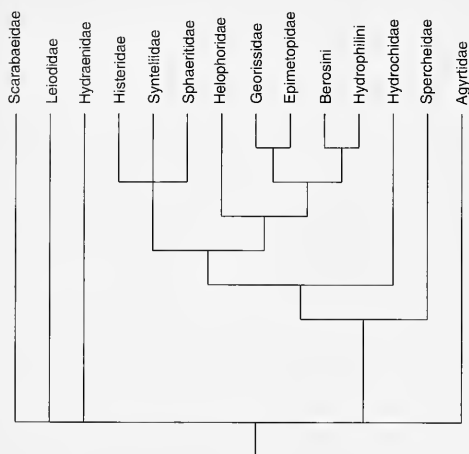


Fig. 29. Strict consensus tree of 33 cladograms.

absent in larvae of Histeroidea (figs. 11, 12). Mm tentoriocardinalis- and tentoriostipitalis are arranged longitudinally. The moveability between cardo and stipes is strongly restricted. The stipes is mesally closed and tube-like (round or ovoid in cross section). The palp is inserted anteriorly. The lacinia is vestigial (some larvae of Hydrochidae; Archangelsky 1997) or completely reduced. M. craniolacinalis is absent. It may have been transformed into a craniostipital muscle which is found in larvae of Hydrophiloidea excl. Spercheidae (fig. 18) (not in the larvae of Histeridae examined; fig. 19).

Gradual reduction of the maxillary groove and articulating membrane, reduction of the moveability between cardo and stipes, the tube-like structure of the stipes, the anterior insertion of the palp, and the reduction of the lacinia, are related to a modified function of the maxilla. The maxilla is not used as a grasping organ as in larvae of Hydraenidae, Agyrtidae, Spercheidae, and others. It is transformed into a more or less antenna-like sensory organ and is used for manipulating food items. It is not restricted to adduction and abduction but may be moved in every direction. A very similar combination of derived character states is also found in larvae of Adephaga excl. Gyrinidae (Beutel 1993), whereas a clearly different, unique condition is found in the predacious larvae of Paederinae and Staphylininae (Beutel & Molenda 1997): the maxillary base is completely enclosed by the sclerotized ventral wall of the head capsule but the moveability between cardo and stipes is fully retained (Beutel & Molenda 1997).

It cannot be ruled out completely that the presence of a strong, hook-like lacinia is a secondary feature of

Spercheidae, which is connected with the primarily non-predacious feeding habits. However, this appears rather unlikely if muscular features and features of the tentorium are taken into consideration.

Another possible plesiomorphy of Spercheidae is the short prepharynx. It is distinctly elongated in other larvae of Hydrophiloidea and Histeroidea. Whether the unusually wide pharynx and the presence of a strongly developed proventriculus is plesiomorphic or an autapomorphy of *Spercheus* is unclear at present. The pharynx is narrowed in other larvae of Hydrophiloidea and Histeroidea and a proventriculus is completely absent.

An elongated prepharyngeal tube and a more or less narrowed pharynx is also found in larvae of Gyrinidae (part.), Haliplidae, Carabidae, and in predacious larvae of elateroid and cantharoid families (Beutel 1993, 1995). However, the prepharynx is short and broad in larvae of Dytiscidae (De Marzo 1979), Paederinae, and Staphylininae (Beutel & Molenda 1997).

The cerebrum of larvae of Spercheidae is located in the posterior part of the head capsule whereas it is completely shifted into the prothorax in other larvae of Hydrophiloidea and Histeroidea examined. Glands are present posterior to the prementum of *Spercheus*. Similar structures are found in non-predacious larvae such as Hydraenidae and Myxophaga (Beutel & Molenda 1997, Beutel et al. 1999). They are absent from all other hydrophiloid and histeroid larvae as far as known at present.

The posterior shift of the cerebrum is probably correlated with the elongated prepharynx, the extension of the clypeofrons, and with a dorsolateral, precerebral extension of the mandibular adductor. The anterior shift of the cerebrum in larvae of Dytiscidae, Paederinae, and Staphylinidae (De Marzo 1979, Beutel & Molenda 1997) is probably a result of the shortening of the prepharynx. In larvae of these taxa the attachment area of M. craniomandibularis is extended posterior to the brain.

The considerable number of presumably plesiomorphic character states found in larvae of Spercheidae (and Hydrochidae) suggests a basal position of these taxa within Hydrophiloidea (figs. 28, 29). This is in contrast to the phylogenetic hypotheses presented by Hansen (1991) and Archangelsky (1998). On one hand, the placements proposed by these authors imply reversal (or parallel evolution) of many characters of the larval head. On the other hand, the presence of a stigmatic atrium seems to be a sound argument in favour of a monophylum which comprises Hydrochidae, Spercheidae, and Hydrophilidae (Archangelsky 1998), or only the latter two families if independent evolution of this feature in hydrochid larvae is assumed (Hansen 1991). However,

it has to be emphasised that this character has been studied in some detail only in larvae of Hydrophilidae. Therefore, it should be treated tentatively in phylogenetic analyses.

Histeroidea group within Hydrophiloidea (excl. Spercheidae and Hydrochidae) in this analysis (fig. 28). This is also in contrast to previous analyses (e.g. Hansen 1991, Beutel 1994, Archangelsky 1998). Histeroidea share a considerable number of presumptive apomorphies with Helophoridae, Georissidae, Epimetopidae, and Hydrophilidae (see above; fig. 28). These are mainly characteristics which seem correlated with advanced predacious habits. Therefore, parallel evolution cannot be excluded. Similar conditions are also found in most larvae of Adephaga and others (see above). Larvae of Histeroidea differ considerably from hydrophiloid larvae if structures are examined in detail. The posterior and anterior tentorial arms are only connected by very thin and soft cuticle. The maxillary groove is absent, whereas it is still distinct in larvae of Helophoridae, Georissidae, and Hydrophilidae. The cardo is not composed of several sclerites but completely fused with the stipes. The maxillary musculature is clearly different from what is found in the larvae of Hydrophiloidea examined (figs. 18-19). The mentum is completely membranous, whereas it is well developed and sclerotized in all larvae of Hydrophiloidea (figs. 9-10; Archangelsky 1997). A dense preoral filter, suitable for preoral digestion in terrestrial habitats, is present in larvae of Histeroidea, but absent from most larvae of Hydrophiloidea examined (present in some sphaeriidiines; Archangelsky, pers. comm.). It is well understood that differences do not mean that groups are not closely related. However, it is evident that a broader set of characters is needed for a clarification of the position of Histeroidea.

Several character states of adults which support the monophyly of Hydrophiloidea (excl. Histeroidea) were presented by Hansen (1997a): antenna 9-segmented, mesocoxal fissure closed, elongated and slender female gonocoxites, anteriorly narrow mesosternum, basally pubescent femora. Other presumptive hydrophiloid autapomorphies (Hansen 1997a) are shared with Hydraenidae (see also Beutel 1994): lateral margin of clypeus long (1.1; numbers refer to Hansen 1997a), head abruptly constricted behind eyes (3.1), mandibles with weak apices (8.1), antennae used as accessory respiratory organs (15.1), plastron on ventral surface (36.1), aquatic habits (119.1). A placement of Hydraenidae within Staphylinioida in a strict consensus of nine equally parsimonious trees (Hansen 1997a: fig. 2) justifies the interpretation of these features as independently evolved apomorphies of Hydrophiloidea.

The present contribution demonstrates that charac-

ter transformations of the larval head in relation with modified feeding habits play a highly important role in the evolution of Hydrophiloidea and Histeroidea. Some of the apomorphies are specific such as the subdivided cardo, the transverse or V-shaped submental suture, and a cranially shifted sclerotized mentum. Others are commonly found and in varying combinations in different other groups with predacious larvae. Considering different larval character sets - e.g. head and abdominal apex - there remains a certain amount of conflicting evidence. An improved knowledge of external and especially internal features of larvae (e.g. Sphaeritidae, Synteliidae, Epimetopidae, Georissidae), detailed comparative studies of phylogenetically important characters (e.g. stigmatic atrium, terminal genital segments of adults), and molecular studies may further improve the understanding of the phylogeny of Hydrophiloidea and related groups of Coleoptera.

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*PROSAETOMILICHIA* DE MEIJERE: A JUNIOR  
SUBJECTIVE SYNONYM OF *MILICHIA* MEIGEN,  
WITH A PHYLOGENETIC REVIEW OF THE  
*MYRMECOPHILA* SPECIES-GROUP  
(DIPTERA, MILICHIIDAE)

Brake, I., 1999. *Prosaetomilichia* de Meijere: a junior subjective synonym of *Milichia* Meigen, with a phylogenetic review of the *myrmecophila* species-group (Diptera, Milichiidae). – Tijdschrift voor Entomologie 142: 31–36, figs. 1–8. [ISSN 0040-7496]. Published 22 September 1999. *Prosaetomilichia* de Meijere, 1909, with the Javanese species *P. brevirostris* and *P. myrmecophila*, is here synonymized with *Milichia* Meigen, 1830, because its type-species, *M. myrmecophila* (de Meijere) comb. n., falls within a monophyletic group in *Milichia*. This group, the *myrmecophila* species-group, is characterized by a specialized hind tibia and a black flap at the subcostal break, and also contains the species *M. farquharsoni* Collin, 1921, *M. formicophila* Deeming, 1976, and *M. patrizii* Hennig, 1952. The *myrmecophila* species-group is part of a larger group of short-faced *Milichia* species. *M. brevirostris* (de Meijere) comb. n. is not a member of the *myrmecophila* species-group, but also belongs to the group of short-faced *Milichia* species.

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Key words. – Milichiidae; *Milichia*; *Prosaetomilichia*; taxonomy; phylogenetic systematics

In 1909 de Meijere erected a new genus, *Prosaetomilichia*, to accommodate two new species from Java, *P. brevirostris* and *P. myrmecophila*. He established this genus on the basis of the shape of the proboscis and the short face, although the species were otherwise similar to *Milichia* Meigen, 1830. Since de Meijere did not fix a type-species, Sabrosky (1977) subsequently designated *P. myrmecophila* as the type-species of *Prosaetomilichia*.

Collin (1921), Hennig (1952), and Deeming (1976, 1979, 1984) described a total of nine new short-faced *Milichia* species from Africa, some of which have an unusually shaped proboscis compared with other *Milichia* species. These authors preferred to retain these species in *Milichia*, because they are undoubtedly closely related to the long-faced species.

A study of the type-specimens of *Prosaetomilichia myrmecophila* and *P. brevirostris* revealed that they belong to the group of short-faced *Milichia* species. The purpose of this paper is to determine the correct systematic position of *Prosaetomilichia* and, having done that, to synonymize *Prosaetomilichia* with *Milichia*. I have concluded that it is best to retain these short-

faced species in *Milichia*, and in this I have followed the view of Collin, Hennig and Deeming. In addition, I designate lectotypes for *M. myrmecophila* and *M. brevirostris*.

*Milichia myrmecophila* (de Meijere, 1909) comb. n.  
(figs. 1–5)

*Prosaetomilichia myrmecophila* de Meijere, 1909: 171. Lectotype ♂ (here designated), Java, 'E. Jacobson / Batavia (= Djakarta) / Aug 1908', ZMAN type DIPT. 0724.4, (ZMAN [examined])

#### Diagnosis

Mostly black species with white microtomentum on tergites three to five of the male abdomen. Lunula very high and shining. Wing with a black flap at subcostal break, hind tibia specialized.

#### Description

Male. – Head black, except for orange first flagellomere, orange vibrissal angle, and brown palpi.

Frons brown microtomentose, twice as long as

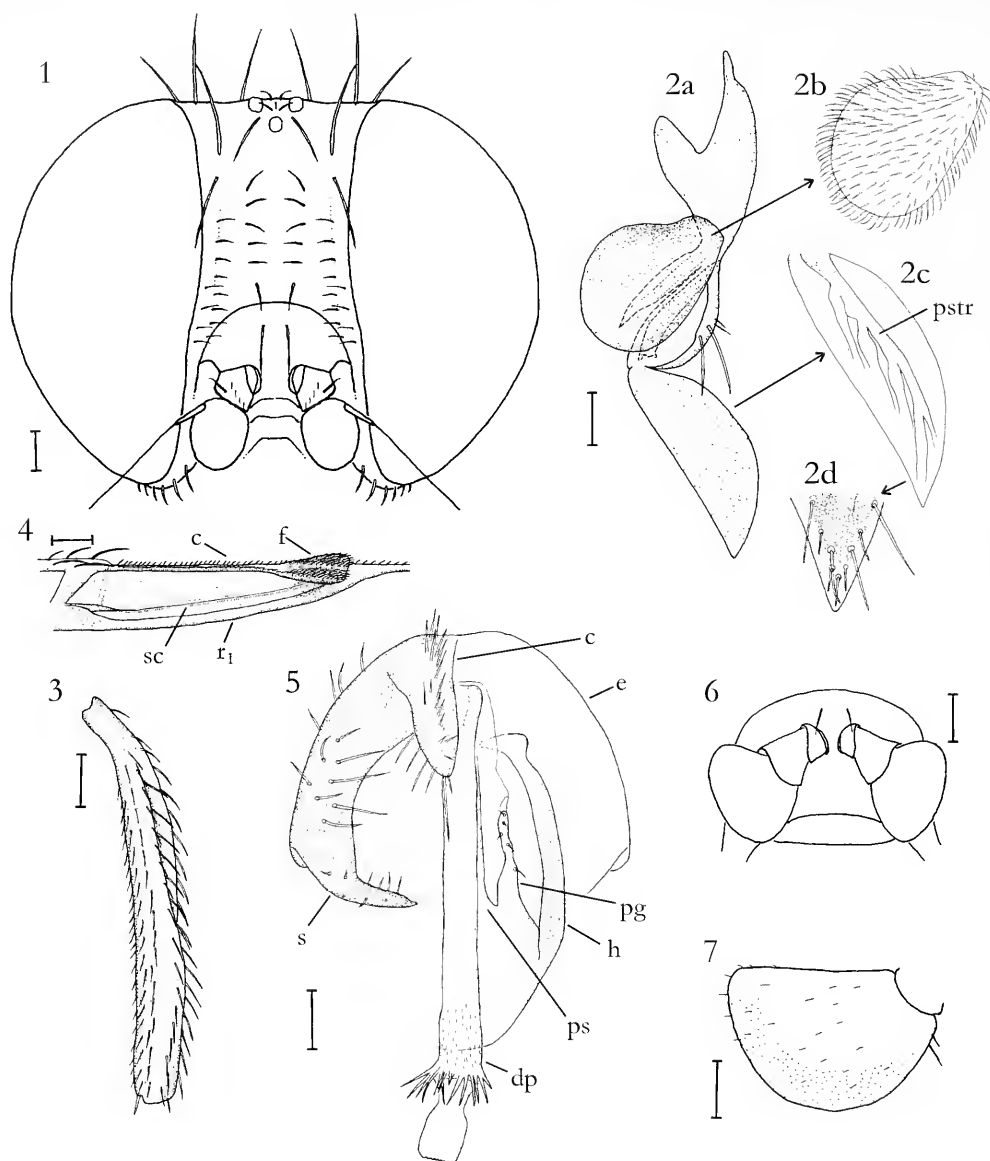


Fig. 1-7. *Milichia* species. – 1-5. *Milichia myrmecophila* male. – 1, head (lectotype), frontal view; 2a, proboscis (non-type), lateral view; b, palpus; c, labellum, dorsal side (pstr, pseudotrachea); d, tip of labellum, ventral view; 3, hind tibia (non-type), posterior side; 4, right wing (lectotype), dorsal view of costal cell (c, costa. f, flap. r<sub>1</sub>, vein R<sub>1</sub>. sc, subcosta); 5, male genitalia (non-type), from beneath (c, cerci. dp, distiphallus. e, epandrium. h, hypandrium. pg, pregonite. ps, phallapodemic sclerite. s, surstylus). – 6-7. *Milichia breviostris* female. – 6, lunule, face and clypeus (lectotype); 7, palpus (paralectotype), lateral view. Scales: 0.1 mm.

broad with concave sides, narrowest at mid-length where it is  $0.28\times$  width of head, at vertex and base of antennae  $0.35\times$  (fig. 1). Interfrontal hairs in a long row of about seven hairs, the anterior hair longest. Frontal triangle small, not extending further than ocelli. Two orbital setae, upper one reclinate, lower one proclinate. No frontal setae, but two rows of inclinate hairs of equal length. The row on inner side of orbital plate consisting of about eight hairs, the row next to the eye placed anteriorly and consisting of about four hairs. Pro- and laterocline ocellar and inner and outer vertical setae present. Postocellar setae slightly converging. Orbital and frontal plates forming one plate, each measuring about one-fifth the width of frons. Orbital setae situated near inner side of plates. Plates shining behind orbital setae, subshining anteriorly. Lunula distinctly shining, with one pair of setae, height about a quarter of the height of frons. Genae narrow, vibrissa strong, followed by a row of bristles which increase in length towards the posterior part of head.

Face short, antennae small, pedicel nearly as long as first flagellomere, which is as long as lunula high. First flagellomere slightly longer than broad. Face and antennae with short pubescence, palpi with hairs of pubescence about twice as long as this. The palpi are round lobes which cover the proboscis at rest (fig. 2a, 2b). Width of palpi about twice, length slightly less than  $3\times$ , height of lunula.

Labium  $2.5\times$ , labella about  $4\times$ , height of lunula. Labella flat, with five shallow pseudotracheae dorsally (fig. 2c) which disappear before they reach margin of labella (fig. 2d). Labella folded together at rest, microtomentose on outside, with several hairs which are as long as interfrontal hairs.

Thorax black. Mesonotum sparsely, scutellum thickly brown microtomentose, pleura grey microtomentose. Basisternum similar to shape 'G' in Speight (1969), without precoxal bridge. Mesonotum and scutellum strongly convex.

Thorax about  $1.3\times$  as long as broad. Length of thorax: 1.2 mm.

Chaetotaxy: 1 postpronotal, 2 notopleural, 1 presutural, 2 postalar, 1 long and 1 very short dorsocentral, 1 long prescutellar, 1 apical and 1 subapical scutellar, 3 katepisternal and no anepimeral setae. Apical scutellar setae cruciate and standing vertically upright. Setae long and conspicuous.

Legs black except for yellowish distal end of fore tibia and base of fore and mid tarsus. Coxae thickly grey microtomentose, rest of legs thinly grey microtomentose except for ventral and posterior side of hind femur and upper side of mid and hind tibiae, which are polished and glabrous. Surface of brilliantly pol-

ished areas on mid and hind tibia flattened, slightly concave, thus forming a sharp anterodorsal ridge on hind tibia (fig. 3). Distal end of fore tibia and basal two tarsomeres with a brush of yellow setulae. Basal three tarsomeres of hind leg with an anteroventral row of very short black setulae next to a narrow brush of yellow-brown setulae.

Fore tibia short (0.5 mm), only  $0.6\times$  length of hind tibia (0.8 mm) (mid tibia: 0.7 mm).

Wings and calypters slightly yellowish, wing with a dark spot at distal end of  $R_1$  and subcosta next to a black flap at costa near subcostal break. The flap has the shape of a narrow triangle, 0.18 mm long and 0.10 mm broad distally (fig. 4). It is microtomentose and the long sides of the triangle are covered with black setulae.  $R_{4+5}$  and  $M_{1+2}$  slightly converging at tip. Last section of  $M_{1+2}$  about 1.5 as long as penultimate section. Cell CuP closed.

Halteres black. Length of wing: 2.9 mm.

Abdomen black, second tergite brown microtomentose except for a polished spot laterally. Third to fifth segments white microtomentose except for distal margin of fifth segment. Tergite 2 with one row of hairs on distal edge and a few scattered hairs. Tergites 3 and 4 with one row of hairs distally. Tergite 5 with a few scattered hairs and some setae at distal end.

Male genitalia (fig. 5) bent under ventral side of abdomen. Surstylus with a pointed tip, not fused to epandrium. Phallapodemic sclerite fused with base of pregonites and with reduced median part of hypandrium. Distiphallus membranous with a ring of hairs near tip.

Body length: 3.3 mm

Female. – Differs from male in having the frons parallel-sided,  $0.4\times$  width of head. Abdomen polished except for middle of tergite two, which is brown microtomentose. All tergites with a few scattered hairs. Flap on wing  $1.4\times$  as long as in male.

Material examined. – Lectotype cited above. – Paralectotypes: 1 male and 1 female on one pin, 'Java Jacobson', ZMAN type DIPT. 0724.6-7 (ZMAN). In addition there are 3 male and 1 female paralectotypes from Aug. 1908, which I did not examine.

Non-type material: Java: 1 male 'E. Jacobson / Batavia / Dec 1908' (ZMAN).

## Remarks

*M. myrmecophila* comb. n. is closely related to *M. farquharsoni* Collin, 1921, *M. formicophila* Deeming, 1976 and *M. patrizii* Hennig, 1952 (see below). It differs from all three by the presence of prescutellar setae. *M. farquharsoni* and *M. patrizii* differ from *M. myrme-*

*cophila* and *M. formicophila* by their palpi and labella which are of a very peculiar shape and are setose in an unusual way. *M. formicophila* differs from *M. myrmecophila* in having the wing-base infuscate and tergite two of the male largely white microtomentose, whereas it is brown microtomentose in *M. myrmecophila*.

*Milichia brevirostris* (de Meijere, 1909) **comb. n.**  
(figs. 6, 7)

*Prosaetomilichia brevirostris* de Meijere, 1909: 172. Lectotype ♀ (here designated), Java, 'E. Jacobson / Batavia (= Djakarta) / Dec 1908', ZMAN type DIPT. 0717.1 (ZMAN) [examined].

[Lectotype originally pinned together with 2 paralectotypes, 2 Formicidae, and 2 Homoptera, but now double staged on a separate pin.]

### Diagnosis

Black species except for orange-yellow base of first flagellomere and palpi and knees. Mesonotum brown microtomentose except anteriorly. Anterior end of mesonotum and pleura grey microtomentose. Distal end of subcosta darkened.

### Description

Female. – Head black except for orange-yellow base of first flagellomere, arista and palpi. First flagellomere and palpi brown only at distal margin.

Frons, lunula, pedicel and face grey microtomentose. Colour of microtomentum on frons changing from grey to brown near vertex. First flagellomere and palpi with white pubescence, which is twice as long on palpi as on first flagellomere.

Frons parallel-sided, 1.2 as long as broad and 0.3 width of head. Interfrontal hairs weak, in a row of about six hairs and with some scattered hairs laterad of the rows, anterior pair longest.

Frontal triangle small, not extending further than ocelli. Two orbital setae, upper one reclinate, lower one proclinate and an additional small proclinate seta placed between these but slightly closer to eye. No frontal setae, but about four hairs. Pro- and lateroclininate ocellar and inner and outer vertical setae present. Postocellar setae parallel. Orbital and frontal plates only distinguished by thicker microtomentum. Lunula short, height about half length of first flagellomere, with one pair of setae (fig. 6). Head in lateral view similar to *M. argyratoides* Collin, 1921 and *M. cornesi* Deeming, 1976 as regards the slight angle in posterior eye margin (Collin 1921: fig. 1, pl. XVII, Deeming 1976: fig. 1). Genae very narrow, vibrissa strong, followed by a row of setae which become shorter at back of head.

Face short (fig. 6), antennae small, pedicel slightly shorter than first flagellomere. First flagellomere slightly broader than long. Palpi semicircular in shape

with rounded edges and a few scattered short setulae (fig. 7). Length of palpi: 0.36 mm, width: 0.23 mm. Proboscis completely covered by palpi at rest. Shape of labella as in *M. myrmecophila*.

Thorax black. Mesonotum and scutellum brown microtomentose, but anterior part of mesonotum and pleura grey microtomentose. Basisternum similar to shape 'G' in Speight (1969).

Chaetotaxy: 1 postpronotal, 2 notopleural, 1 presutural, 1+2 supraalar, 2 postalar, 1 long and 1 short dorsocentral, 1 long prescutellar, 1 cruciate apical and 1 subapical scutellar, 3 katepisternal and no anepimeral setae. Setae long and conspicuous.

Legs black except for yellow knees; grey microtomentose, but polished and glabrous posteriorly on hind femur. Basal two tarsomeres of hind leg with an anteroventral row of short setulae and a ventral brush of yellow setulae.

Wings and calypters hyaline, veins yellow-brown. Distal end of subcosta and  $R_1$  and costa proximal to subcostal break darkened.  $R_{4+5}$  and  $M_{1+2}$  parallel. Distal section of  $M_{1+2}$  slightly longer than penultimate section. Cell CuP closed. Halteres black. Length of wing: 2.6 mm.

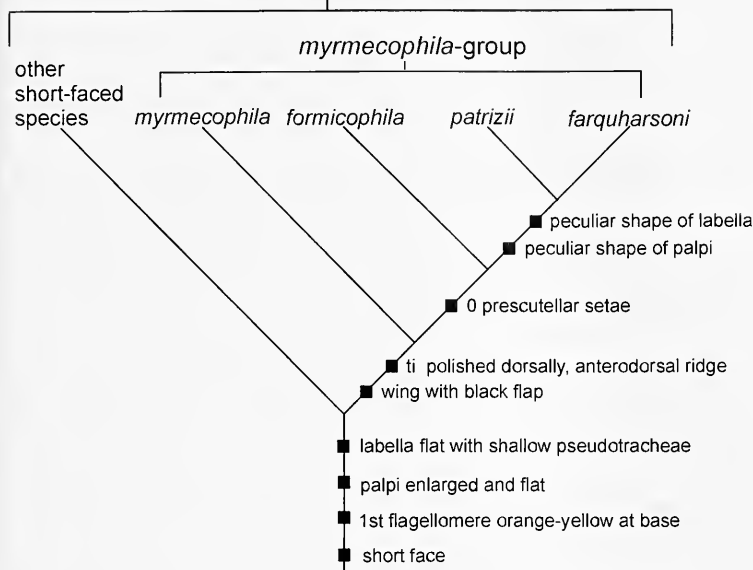
Abdomen black, tergites brown microtomentose except for tergite 1 and basal half of tergite 2, which become more greyish laterally, and except for hind margins of tergites 2-5, which are grey microtomentose. Shoulders of tergite 2 with a tuft of setae.

Body length: 2.0 mm.

Material examined. – Lectotype cited above. – Paralectotypes: 2 females pinned together with 2 Formicidae, and 2 Homoptera; Java, 'E. Jacobson / Batavia (= Djakarta) / Dec 1908', ZMAN type DIPT. 0717.2-3 (ZMAN). 1 female, 'Java Jacobson', ZMAN type DIPT. 0717.4 (ZMAN).

### Remarks

*M. brevirostris* comb. n. belongs to the short-faced species of the genus *Milichia*, sharing the pale first flagellomere, flattened labella, and yellow knees. It is most closely related to *M. argyratoides*, sharing the hyaline wings with darkened end of subcosta and the grey microtomentum anteriorly on the otherwise brown microtomentose mesonotum, but it differs by the colour of the microtomentum on frons, pleura and abdomen. In *M. argyratoides* these parts are completely brown microtomentose, whereas they are partly grey in *M. brevirostris*. In addition, *M. argyratoides* is about twice as long as *M. brevirostris* and is stouter.

short-faced species of *Milichia*Fig. 8 . Cladogram of the short-faced *Milichia* species.

## PHYLOGENETIC SYSTEMATICS

The genus *Milichia* belongs to the subfamily Milichiinae of the Milichiidae. As yet no apomorphies have been identified for this genus. It is characterized by a combination of the following plesiomorphies: anepimeron bare (in contrast to *Pholeomyia* Bilimek, 1867) and posterior margin of eye entire (in contrast to *Milichiella* Giglio-Tos, 1895 and *Ulia* Becker, 1907). The short-faced *Milichia* species as characterized below belong to the genus *Milichia* because they share all the generic characters mentioned by Hennig (1938) except for the proboscis, which has elongated labella, and except for the wing, in which  $R_{4+5}$  and  $M_{1+2}$  may converge slightly. The male genitalia are rather similar throughout the genus, but they are only known in a few species.

The short-faced *Milichia* species constitute a monophyletic group, with several apomorphic characters (fig. 8): 1. short face (plesiomorphic: long face), 2. first flagellomere orange-yellow at base (plesiomorphic: first flagellomere black), 3. palpi enlarged and flat (plesiomorphic: palpi small and spatulate), and 4. labella flattened with shallow pseudotracheae (plesiomorphic: not flattened, with normal pseudotracheae). The *myrmecophila* species-group belongs to the short-faced group. Apomorphic characters of the *myrmecophila* species-group are: a black flap on the wing (plesiomorphic: no black flap), and hind tibia polished dorsally, with an anterodorsal ridge (plesiomorphic: hind tibia without a ridge). The group

consists of the species *M. farquharsoni*, *M. formicophila*, *M. myrmecophila* and *M. patrizii*. *M. patrizii* and *M. farquharsoni* are sister species with synapomorphies in the palpi and labella, which are both very peculiar in shape and are setose in an unusual way. Together they form the sister-group of *M. formicophila*, with the loss of the prescutellar setae as a synapomorphy.

## BIOLOGY

The short-faced *Milichia* species are probably all myrmecophilous, and so far as is known they have a common behaviour in that there is a feeding interaction between the adult flies and ants, unlike other myrmecophilous Milichiidae such as *Pholeomyia* and *Phyllomyza* Fallén, 1810 where no such interaction has been observed. Instead, the larvae of *Pholeomyia* and *Phyllomyza* have been found in ants nests, where they probably feed on detritus (Moser & Neff 1971, Donisthorpe 1927). The adults of *Milichia dectes* Collin, 1921, *M. proectes* Collin, 1921, and *M. prosaetes* Collin, 1921 are known to receive regurgitated food from *Crematogaster* ants (Collin 1921, Farquharson 1921). *M. breviostris* licks the anal secretion of the ant *Dolichoderus bituberculatus* or feeds directly on honey dew from Homoptera (Membracidae) (de Meijere 1909). *M. myrmecophila* is thought to lick the anal secretion of *Crematogaster difformis*: Jacobson (1909) could not really see this, but observed the flies following the ants with their proboscis

near the abdominal tip of the ants. It is also possible that the flies feed on the abdominal contents of the ants, as described for *Rhynchopsilopa* flies (Ephydriidae) and *Crematogaster* ants (Freidberg & Mathis 1985). *M. farquharsoni* was observed 'haunting the nests of *Crematogaster* ants', but the exact nature of its behaviour could not be resolved. And, finally, the larvae of *M. argyratoides* were found on the running wound of a *Crematogaster* ant-tree, covering themselves with excreta. One *Crematogaster* ant was observed to carry away some of the excreta from the surface of the larva (Farquharson 1921). It would be very interesting to study the biology of this group of flies in greater detail.

#### ACKNOWLEDGEMENTS

I am grateful to Dr. H. de Jong (ZMAN, Zoological Museum Amsterdam, Netherlands) for the loan of the *Prosaetomilichia* specimens, to D. J. Mann (Hope Entomological Collections, Oxford) for the loan of *Milichia farquharsoni* and *M. argyratoides*, and to Dr. M. von Tschirnhaus (Universität Bielefeld) for the loan of several *Milichia* species.

I thank Prof. Dr. W. Sudhaus for critically reviewing the manuscript.

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# SEVENTEEN NEW *HELICOPSYCHE* SPECIES FROM NEW CALEDONIA (TRICHOPTERA, HELICOPSYCHIDAE)

Johanson, K. A., 1999. Seventeen new *Helicopsyche* from New Caledonia (Trichoptera, Helicopsychidae). – Tijdschrift voor Entomologie 142: 37–64, figs. 1–114. [ISSN 0040-7496]. Published 22 September 1999.

The Helicopsychidae fauna of New Caledonia is revised. Seventeen new *Helicopsyche* species are described: *H. arma* sp.n., *H. baroua* sp.n., *H. patriciae* sp.n., *H. fusca* sp.n., *H. kogbiensis* sp.n., *H. livida* sp.n., *H. nigrospinosa* sp.n., *H. ouaroua* sp.n., *H. pellmyri* sp.n., *H. penicilla* sp.n., *H. rossi* sp.n., *H. tenuisa* sp.n., *H. browni* sp.n., *H. neocaledonia* sp.n., *H. gibbsi* sp.n., *H. rembai* sp.n., and *H. unilobata* sp.n. A key to the males of the New Caledonian *Helicopsyche* is provided.

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Keywords. – Trichoptera; Helicopsychidae; *Helicopsyche*, new species; New Caledonia.

Twelve *Helicopsyche* species were previously described from New Caledonia (Johanson & Scheffer 1999, Ross 1975). Ross (1975) described the males of *H. edmundsi* Ross, 1975, *H. petersorum* Ross, 1975, *H. vallonina* Ross, 1975, *H. starmuehlneri* Ross, 1975, *H. caledonia* Ross, 1975, *H. lapidaria* Ross, 1975, *H. hollowayi* Ross, 1975, *H. boularia* Ross, 1975, *H. asymmetrica* Ross, 1975, *H. kariona* Ross, 1975, *H. arenaria* Ross, 1975 and *H. koumaka* Ross, 1975. Johanson and Scheffer (1999) re-described the males and included descriptions of the female sex, and larval and pupal stages as well. Ross (1975) separated the twelve species into four species groups. The *vallonina*-group includes *H. vallonina* and *H. kariona*; the *edmundsi*-group includes *H. edmundsi*, *H. asymmetrica* and *H. petersorum*; the *lapidaria*-group includes *H. starmuehlneri*, *H. caledonia*, *H. lapidaria*, *H. boularia* and *H. hollowayi*; and finally the *arenaria*-group includes *H. koumaka* and *H. arenaria*. The phylogenetic significance of this grouping is at present not evaluated.

Johanson (1995, 1997 and 1998) indicated that New Caledonia is among the hot spots in Helicopsychidae, and detection of the species described herein supports the idea of such a hot spot. The aim of this work is to add knowledge to the genus *Helicopsyche* of New Caledonia.

Type depositories are as follows: Royal Ontario Museum, Ottawa, Canada [ROM], National Museum of Natural History, Smithsonian Institution, Washington D.C., USA [NMNH], Canterbury Museum, New Zealand [CM], Bishop Museum, Hawaii

[BMH] and Ian M. Henderson private collection [IHPC].

## DESCRIPTION OF NEW SPECIES

### *Helicopsyche pellmyri* sp. n. (figs. 1–11)

#### Type material

Holotype, ♂ (in alcohol), NEW CALEDONIA: Mt. Koghi, 400m, 12–14.xi.1986, UV trap (R. Brown & O. Pellmyr) (NMNH).

Paratypes, 15 ♂ (in alcohol), as holotype; 2 ♂, 1 ♀ (pinned), as holotype; ditto, but 1 ♂ (pinned), 460m, 29.xii.1976 (R. E. Dietz IV); 2 ♂, 12 ♀ (in alcohol): Mt. Konanéoa, Les Dalmates, 166°40'30"E, 22°12'30"S, UV trap, 19.x.1986 (R. Brown & O. Pellmyr) (NMNH); 3 ♂, 2 ♀ (in alcohol): Col de Mouirange, 210m, 27.x.1986, UV trap (R. Brown & O. Pellmyr) (NMNH); ditto, but 1 ♂, 2 ♀ (in alcohol), 225m; 16 ♂, 2 ♀ (in alcohol): 5 km S Touho, 100m, Panandou River, 165°13'E, 20°49'S, 22–23.ii.1984 (M. Pogue & M. Epstein) (NMNH).

#### Diagnosis

Male *H. pellmyri* sp. n. are distinguished from other *Helicopsyche* species by the anterodorsally produced and edged IXth segment (fig. 3); the about twelve Xth tergal megasetae (figs. 5,7); the strongly mediad curved gonocoxal secondary branches (fig. 6); and the tuboid and slightly laterad angled basomedian branches (fig. 6).

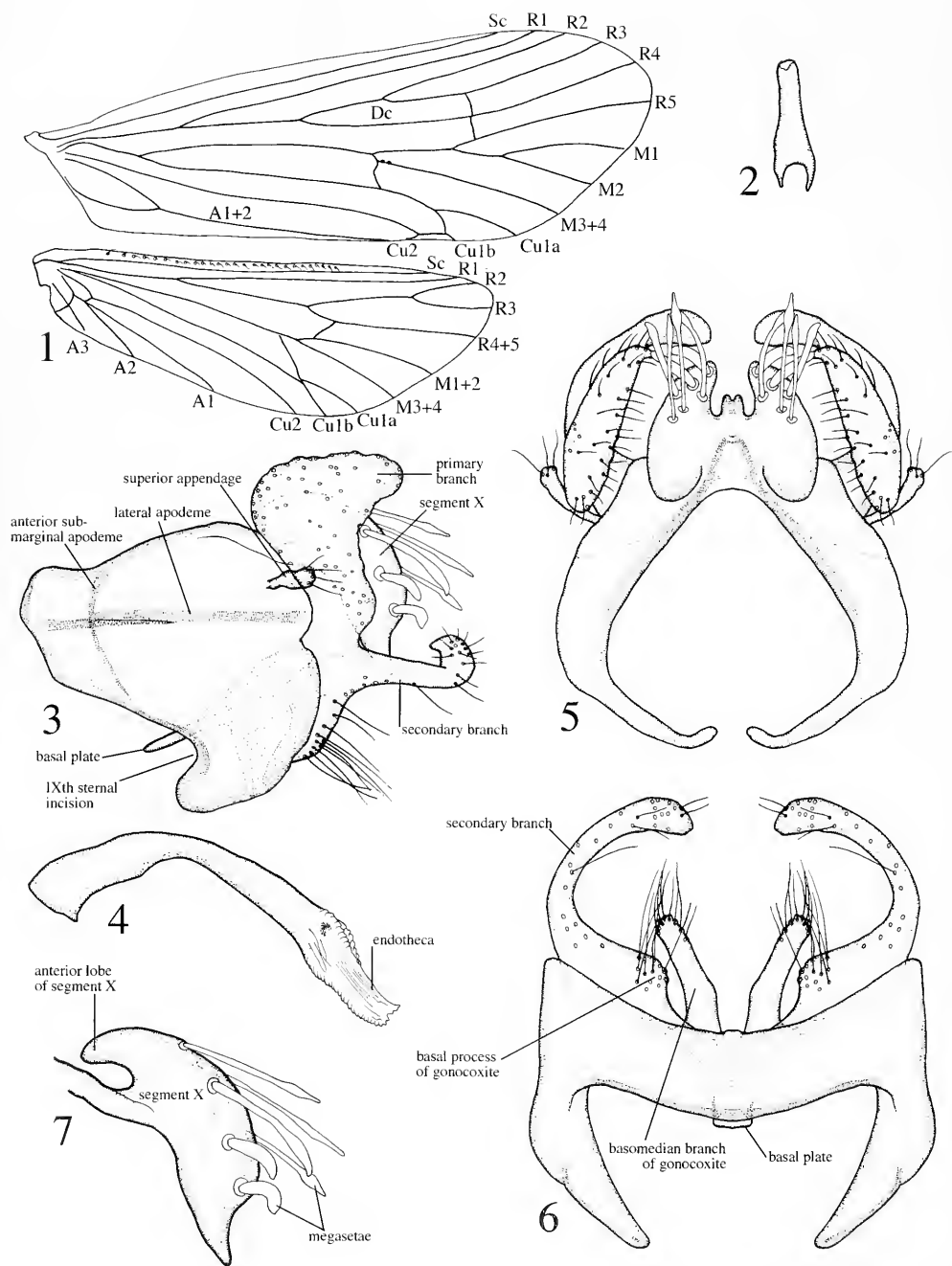


Fig. 1-7. *Helicopsyche pellmyri* sp. n., male. – 1, right wings; 2, VIth sternal process; 3, genitalia, lateral view; 4, phallus, lateral view; 5, genitalia, dorsal view; 6, genitalia, ventral view; 7, Xth tergum, lateral view.

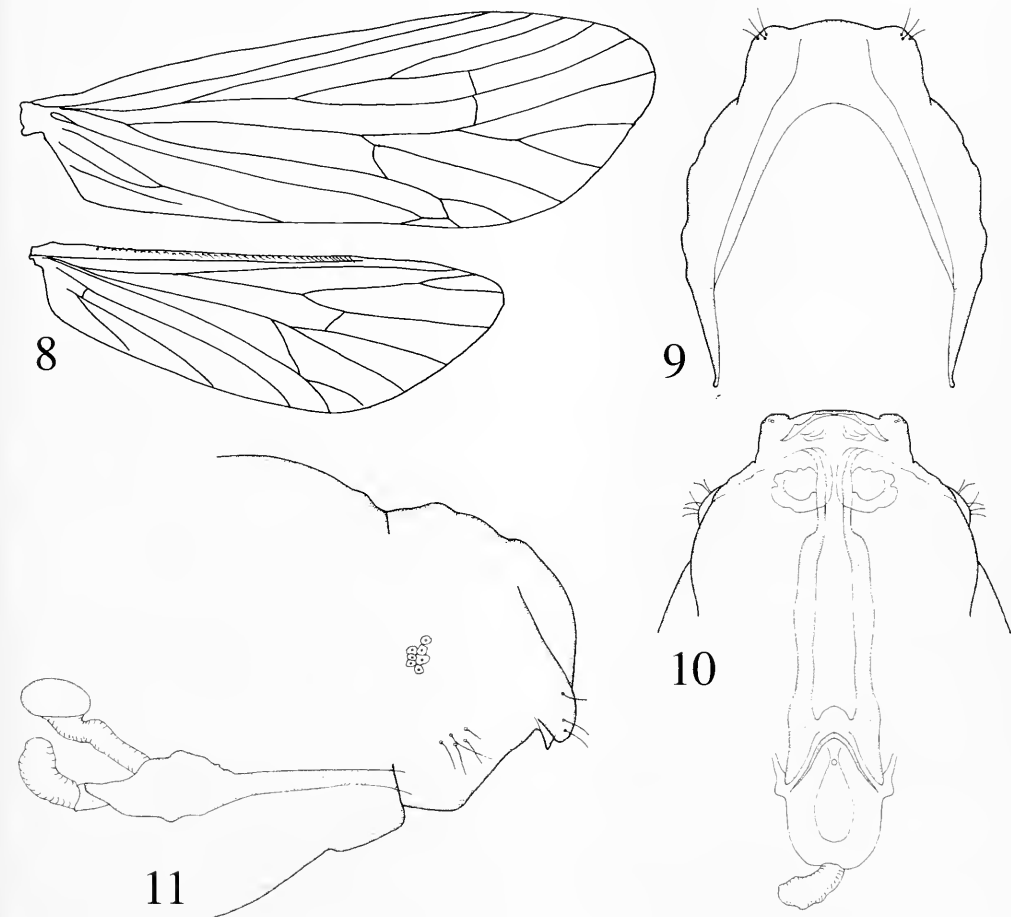
### Etymology

*H. pellmyri*, after O. Pellmyr, one of the collectors of the holotype.

### Description

Male (figs. 1-7). – Head: maxillary palp joints equally long; scape about as long as basal joint of maxillary palp; 51 flagellomeres. Cephalic warts strongly pyriform, extended towards anterior head margin. Interantennal warts absent. Wings (fig. 1): fore wing 6.3 mm; fork 1 originates about midway on Dc; Dc nearly twice  $M_2$  length;  $M_2$  about  $2\times$  longer than distal part of  $M_{1+2}$ ; crossvein M-Cu meets  $Cu_1$  at some distance before bifurcation of  $Cu_1$ , this distance is about equal to the length of  $Cu_{1+2}$ ; Crossvein  $Cu_1-Cu_2$  present. Posterior wing 4.7 mm; 27 hamuli;  $R_{2+3}$  about  $1.5\times$  longer than  $R_3$ ; Crossvein M-Cu tangent

to point of bifurcation of  $Cu_1$ ; basal brush of long, dark setae, and scaloid setae absent. Fore leg posterior spur length about  $0.5\times$  anterior spur length. Abdomen with VIth sternal process well developed (fig. 12). Genitalia (figs. 3-7): IXth segment produced anterodorsad; submarginal apodeme well developed (fig. 3). IXth sternal incision V-shaped, wide and deep (fig. 3). Superior appendage originates at some distance dorsally to lateral apodeme and directed posteriad. Xth tergum, lateral view, strongly produced dorsally and expanded anteriorly, forming an anterior lobe (figs. 3, 5, 7). Xth tergal megasetae present in two groups: an anterior group includes four long, drop-shaped megasetae, and a postero-lateral group includes two knife-shaped megasetae (figs. 5, 7). Xth tergum dorsal margin about parallel with ventral margin in lateral view, tapers strongly towards apex (fig.



Figs. 8-11. *Helicopsyche pellmyri* sp. n., female. – 8, right wings; 9, genitalia, dorsal view; 10, genitalia, ventral view; 11, genitalia, lateral view.

7). Gonocoxal primary branch about  $4\times$  broader than secondary branch (fig. 3); strongly sigmoid, with anterior and dorsal margins acute angled (fig. 3); longer than secondary branch. Secondary branch strongly curved mediad, with apex slightly club-shaped (fig. 6); having broad basal part produced into a rounded process (fig. 6). Basomedian branch, lateral view, slightly club-shaped (fig. 3); in ventral view, parallel sided, slightly angled at basal part (fig. 6). Basal plate anteriorly broad, apex truncate (fig. 6). Phallus (fig. 4) without sclerous processes; lateral view, basally about  $2\times$  as wide as median part; angled ventrad at about  $\frac{1}{3}$  its length.

Female (figs. 8-11). – Wings (fig. 8): Fore and hind wings as in male, except posterior wing with 40 hamuli and crossvein M-Cu meets  $Cu_1$  some distance before bifurcation of  $Cu_1$ . Abdominal VIth sternal process well developed. Genitalia with a lateral setae group located on ventrolateral part of segment IX (figs. 9-11). Lateral comb forms distinct process located medially on segment IX (figs. 10, 11). Segment X with dorsal branch as long as ventral branch, dorsal branch broad and partly hides the ventral branch in lateral view (fig. 11); dorsal branch slightly produced in dorsal aspect; with few, short apical setae (figs. 9, 11). Vagina (fig. 10) sclerotized along its length, with a pair of lateral, transverse ring-like structures situated close to posterior end of vagina (fig. 10). Vaginal sclerite, ventral view, about parallel sided; anteriorly rounded (fig. 10).

Larva and pupa. – Unknown.

***Helicopsyche koghiensis* sp. n.**  
(figs. 12-18)

**Type material**

Holotype, ♂ (in alcohol), NEW CALEDONIA: Koghi R., Mts de Koghi, 250m, 10.i.1966 (G. F. Edmunds) (ROM).

**Diagnosis**

*H. koghiensis* sp. n. can be distinguished from other *Helicopsyche* species by the hind wing which has a brush of long, dark anal setae and scaloid setae arranged along  $A_1$  and  $Cu_2$  (fig. 12); the long, thin, ventrally curved and apically pointed Xth tergum (fig. 15); and the shape of the gonocoxal primary branch (fig. 15).

**Etymology**

*H. koghiensis*, named after Koghi Mts.

**Description**

Male. – Head: maxillary palp joints equally long;

scape about as long as basal maxillary palp joint; flagella broken. Cephalic warts pyriform, expanded towards anterior head margin. Wings (figs. 12-14): Fore wing 4.0mm; fork 1 originates distally on Dc; Dc about  $1.7\times$  longer than  $M_2$ ;  $M_2$  about  $1.8\times$  longer than distal part of  $M_{1+2}$ ; crossvein M-Cu meets  $Cu_1$  at some distance basally to bifurcation of  $Cu_1$ , the distance is about  $1.4\times$   $Cu_{1b}$ ; crossvein  $Cu_1$ - $Cu_2$  apparently absent. Hind wing 3.4 mm; 27 hamuli; crossvein M-Cu fuses with fork 5;  $R_2$  length about  $0.5\times$   $R_{2+3}$  length; anal area with brush of long, dark setae (figs. 12, 14);  $Cu_2$  and  $A_1$  covered by scaloid setae (figs. 12, 13). Fore leg posterior spur length about  $0.5\times$  anterior spur length. Abdomen: VIth sternal process well developed. Genitalia (figs. 15-18): segment IX without anterior submarginal apodeme; anteriorly rounded, slightly detached anteriorly to transverse tergal apodeme (fig. 15); sternal incision absent (fig. 15). Superior appendage slender, slightly club shaped (figs. 15-17). Xth tergum deeply cleaved (fig. 17); curves smoothly ventrad and tapers apically (fig. 15); without megasetae; with two pairs of basal setae, four pairs of apical setae (figs. 15, 17). Gonocoxite with primary and secondary branches about equally long (fig. 15); primary branch basally bent posterodorsad, with rounded apex in lateral view (fig. 15); in dorsal view (fig. 17) overlaying Xth tergum, pointed; secondary branch tapers and curves ventrad (fig. 15), medially substraight but apically slightly curved mediad (fig. 18); basally produced into broad process (fig. 18); basomedian branch short, club shaped, slightly curved mediad (figs. 15, 18). Basal plate (figs. 15, 18) short, thin and anteriorly rounded. Phallus (fig. 16) without sclerous processes; basally substraight; medially strongly bent ventrad.

Female, larva, pupa. – Unknown.

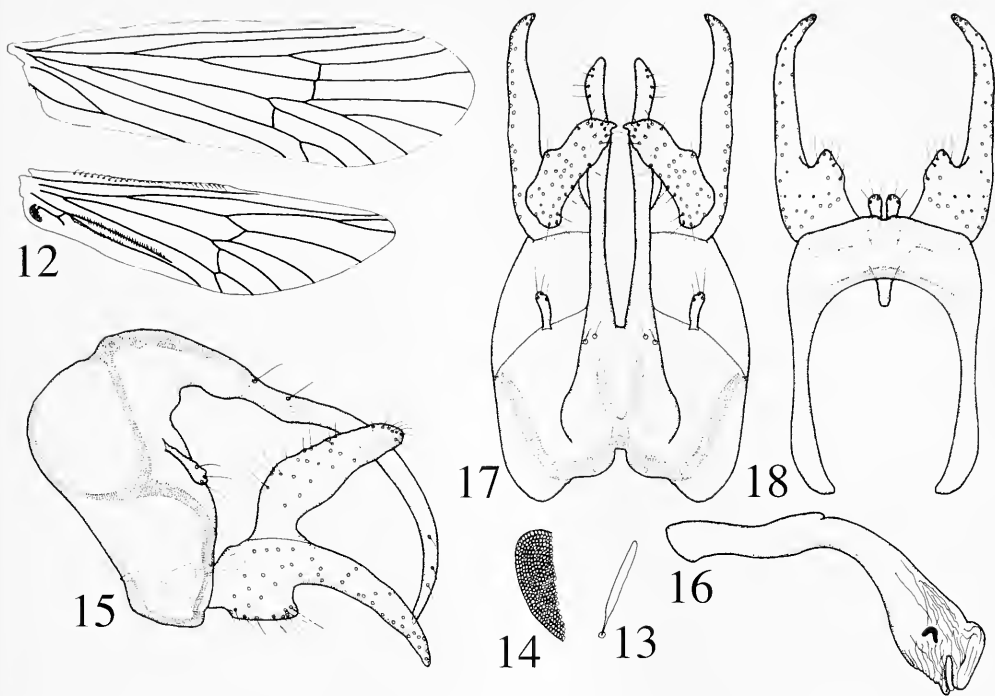
***Helicopsyche arma* sp. n.**  
(figs. 19-23, 94)

**Type material**

Holotype, ♂ (pinned), NEW CALEDONIA: Mt. Dzumac, 820m,  $166^{\circ}26'40''E$ ,  $22^{\circ}3'S$ , 25.x.1986, UV trap (R. Brown & O. Pellmyr) (NMNH).

**Diagnosis**

*H. arma* sp. n. can be distinguished from other *Helicopsyche* species by the highly sclerotized lateral Xth tergal processes (figs. 19, 20); the sickle shaped primary gonocoxal branch (fig. 19); the strongly produced basal process (figs. 19, 21); the short, apically undulated basomedian gonocoxal branches; and the spine shaped apical sclerous phallic processes (fig. 23).



Figs. 12-18. *Helicopsyche koghiensis* sp. n., male. – 12, right wings; 13, scaloid seta from cubital veins, highly magnified; 14, group of setae bases in anal region, highly magnified; 15, genitalia, lateral view; 16, phallus, lateral view; 17, genitalia, dorsal view; 18, genitalia, ventral view.

### Etymology

*H. arma*, from Latin, arms, weapons, tools, refers to the strongly sclerotized, additional processes on the Xth tergum.

### Description

Male. – Wings (fig. 94). Fore wing base color is dark brownish, without particular metallic reflections; with a broad silver-blue band in R-section and a small silver-blue spot in distal A-region. In sunlight the spots appear silver blue, metallic red or white, depending on light angle. Posterior wings anal area, below the long setae brush, is covered by microtrichia which gives a deep blue color in sunlight. The anal brush appears pale brownish in sunlight. Genitalia (figs. 19-23): IXth segment subtrianguloid in lateral view (fig. 19); submarginal apodeme absent; sternal incision small; anterior sternal margin substraight (fig. 19). Superior appendage originates from posterior margin of Xth segment (fig. 19); club shaped. Xth tergum, lateral view (fig. 19), basally enlarged into a dorsal process; distal half slender, substraight, and with dorsal and ventral margins about parallel; without megasetae; apex deeply incised. Xth tergum with

three pairs of strongly sclerotized processes as in figs. 19 and 20. Gonocoxite with circle shaped, dilated primary branch; secondary branch substraight, apically slightly curved dorsad (fig. 19). Basal process of gonocoxite strongly produced posteriad, tube shaped (figs. 19, 21). Basomedian branch apparently completely fused with basal part of gonocoxite (fig. 21); apex with erected, bulbous setae bases. Basal plate short, pointed (fig. 21). Phallus with a pair of dorsal, apically pointed sclerous processes (fig. 23); gently curved ventrad (fig. 22); basally slender and dilates smoothly posteriorly (fig. 23).

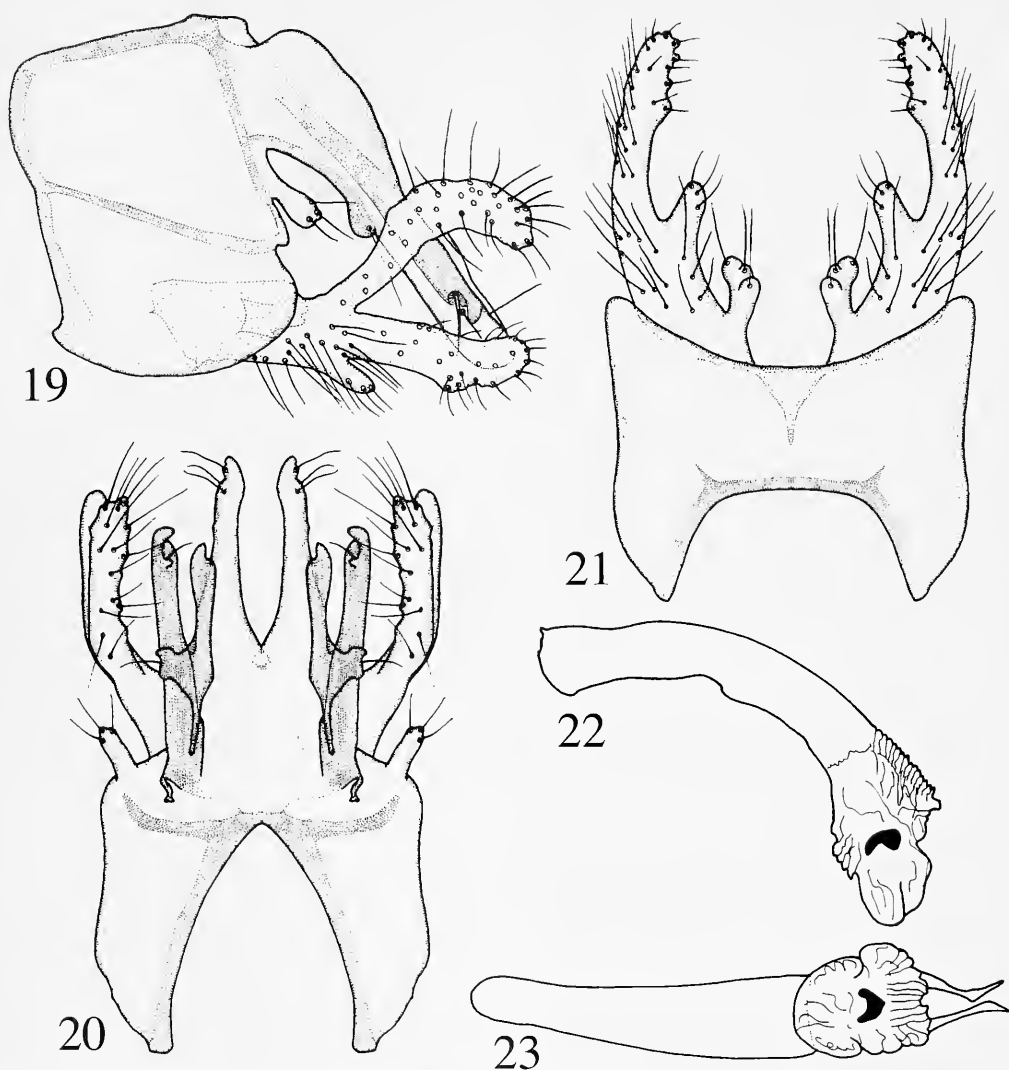
Female, larva and pupa. – Unknown.

### *Helicopsyche rossi* sp. n.

(figs. 24-30)

### Type material

Holotype, ♂ (in alcohol), NEW CALEDONIA: La Crouen, 31.i.1963, light trap (C. Yoshimoto & N. Krauss) (ROM).



Figs. 19-23. *Helicopsyche arma* sp. n., male. – 19, genitalia, lateral view; 20, genitalia, dorsal view; 21, genitalia, ventral view; 22, phallus, lateral view; 23, phallus, ventral view.

# **Diagnosis**

*H. rossi* sp. n. can be distinguished from other *Helicopsyche* species by the Xth tergum which is densely covered by long, drop shaped megasetae (figs. 28, 30); the broad gonocoxal basomedian branches (fig. 29); and the strongly ventrad curved phallus (fig. 26).

# **Etymology**

*H. rossi*, named after H. H. Ross.

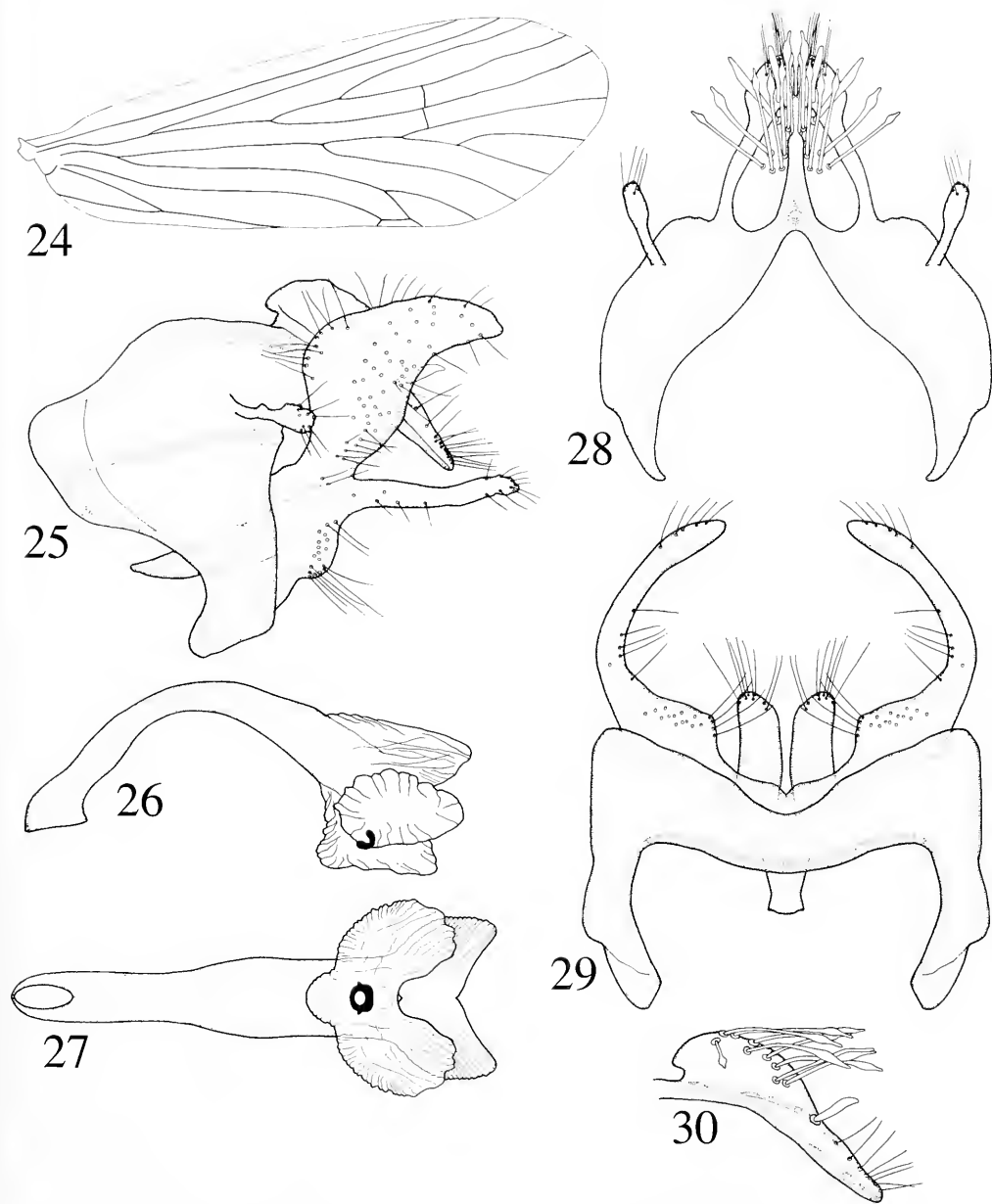
# **Description**

Male. – Head unknown. Fore wing (fig. 24) 7.2

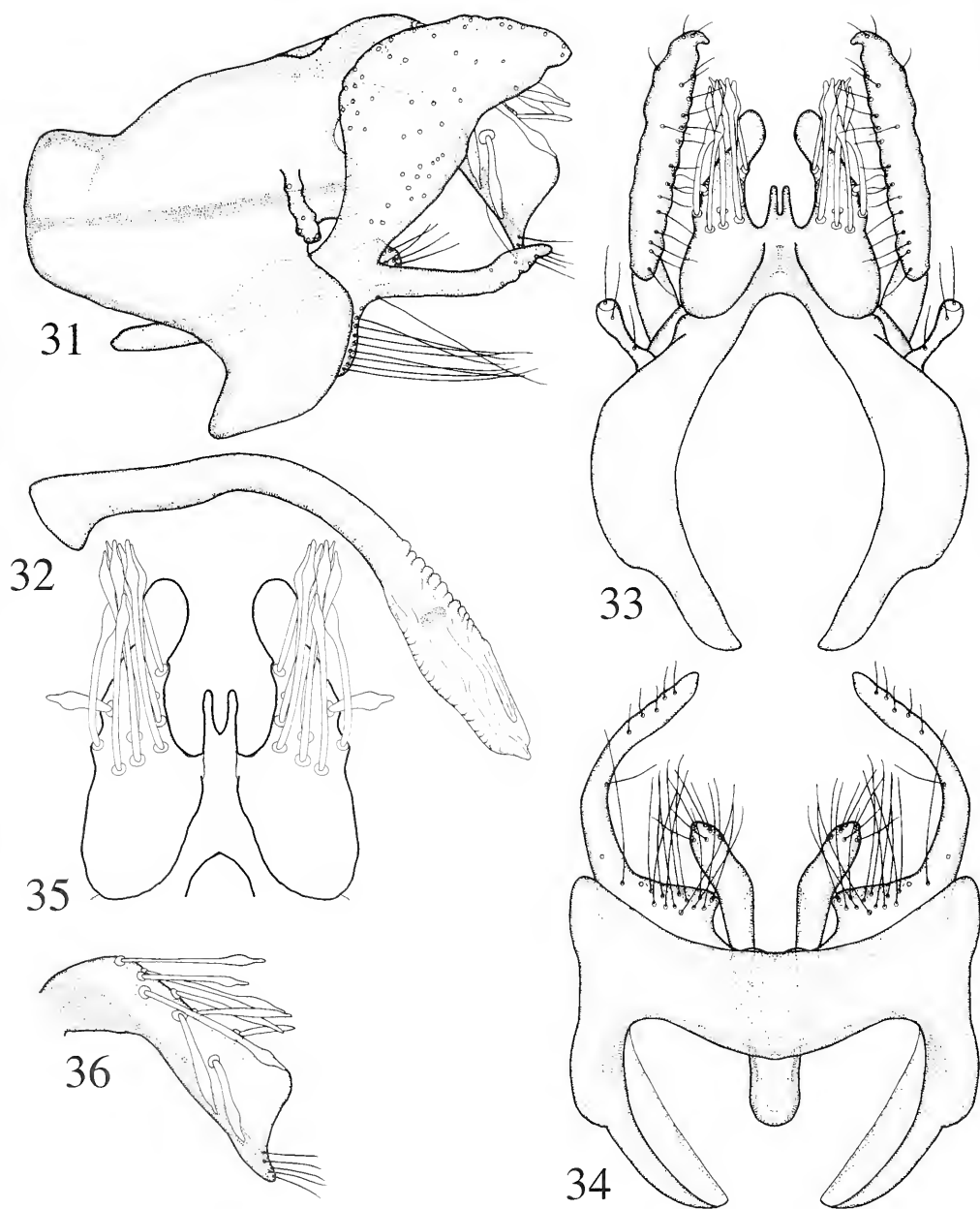
mm; fork 1 originates medially on Dc; Dc about  $1.6\times$  longer than  $M_2$ ;  $M_2$  nearly  $2\times$  longer than distal part of  $M_{1+2}$ . Hind wing unknown. Genitalia (figs. 25-30): IXth segment, lateral view (fig. 25) slightly produced anteriad; submarginal apodeme well developed; sternal incision deep and wide; dorsal margin strongly convex. IXth segment, dorsal view (fig. 27), with sigmoid median margins. Superior appendage long, slender, club shaped, originates at some distance from lateral apodeme (figs. 25, 28). Xth tergum, lateral view (figs. 25, 30), strongly produced dorsad and with a small anterior lobe;

about nine drop shaped megasetae in basal group, and a knife shaped megaseta medially (figs. 28, 30); apically gently tapering, with group of about eight dorsal setae (fig. 30). Gonocoxite, lateral view (fig. 25), with broad, sigmoid primary branch and slender, tuboid secondary branch. In ventral view

(fig. 29) secondary branches gently curved basad; basal branch of gonocoxite slightly edged. Basomedian branches well developed; subparallel in lateral and ventral views (figs. 25, 29), slightly curved laterad (fig. 29). Basal plate long, anteriorly slightly truncated (fig. 29). Phallus without sclerous proces-



Figs. 24-30. *Helicopsyche rossi* sp. n., male. — 24, Right fore wing; 25, genitalia, lateral view; 26, phallus, lateral view; 27, phallus, ventral view; 28, genitalia, dorsal view; 29, genitalia, ventral view; 30, Xth tergum, lateral view.



Figs. 31-36. *Helicopsyche neocaledonia* sp. n., male. – 31, genitalia, lateral view; 32, phallus, lateral view; 33, genitalia, dorsal view; 34, genitalia, ventral view; 35, Xth tergum, dorsal view; 36, Xth tergum, lateral view.

ses; strongly curved ventrad (fig. 26); posterior half about 2× broader than basal half (fig. 27).

Female, larva and pupa. – Unknown.

***Helicopsyche neocaledonia* sp. n.**  
(figs. 31–36)

**Type material**

Holotype, ♂ (in alcohol), NEW CALEDONIA: tributary Nehoue River, Koumac-Bonde-Ouegoua Road, 18.ix.1965 (F. Starmuhlnert) (111/2) (ROM).

Paratypes, 2 ♂ pupae (in alcohol), as holotype, (ROM).

**Diagnosis**

*H. neocaledonia* sp. n. can be distinguished from other *Helicopsyche* species by the IXth segment which is anteriorly produced into a rectanguloid process (fig. 31); the basomedian branches of gonocoxite that are slightly laterad angled (fig. 34); and by the presence of two groups of about eight drop shaped and one thick Xth tergal megasetae (figs. 35, 36).

**Etymology**

*H. neocaledonia*, after NEW CALEDONIA.

**Description**

Male. – Head and wings unknown. Genitalia (figs. 31–36): IXth segment, lateral view (fig. 31), produced anterodorsad into a rectangle; dorsal margin slightly convex; with well developed submarginal apodeme; sternal incision deep and broad. IXth median tergal margins ovoid in dorsal view (fig. 33). Superior appendage tuboid, originates at some distance dorsally to lateral apodeme (fig. 31). Xth tergum, lateral view (fig. 36), strongly produces dorsad and tapers strongly towards apex; with basal group of about eight drop shaped megasetae and a single lateromedian, drop shaped megaseta (figs. 31, 35, 36); apical incision with two small, median lobes (fig. 35). Gonocoxite, lateral view (fig. 31), with broad primary branch having strongly convex anterior margin and substraight posterior margin; secondary branch tuboid (figs. 31, 34), curved mediad, basal process pointed. Basomedian branches angled laterad in ventral view (fig. 34), and club shaped in lateral view (fig. 31). Basal plate long, broad and anteriorly rounded (figs. 31, 34). Phallus (fig. 32) as in *H. rossi* sp. n.

Female and larva. – Unknown.

***Helicopsyche browni* sp. n.**  
(figs. 37–43)

**Type material**

Holotype, ♂ (in alcohol), NEW CALEDONIA: Riviere Bleue, 166°40'20"E, 22°6'S, 8.xi.1986, UV trap (R. Brown & O. Pellmyr) (NMNH).

Paratypes, 2 ♂ (in alcohol), NEW CALEDONIA: stream on Mt. Pouéhihi, 15 km W of Ouénarou Forest Station, on Eaux et Forêts Road, 153 m., N50, 5.xi.1972 (W. L. & J. G. Peters) (ROM).

**Diagnosis**

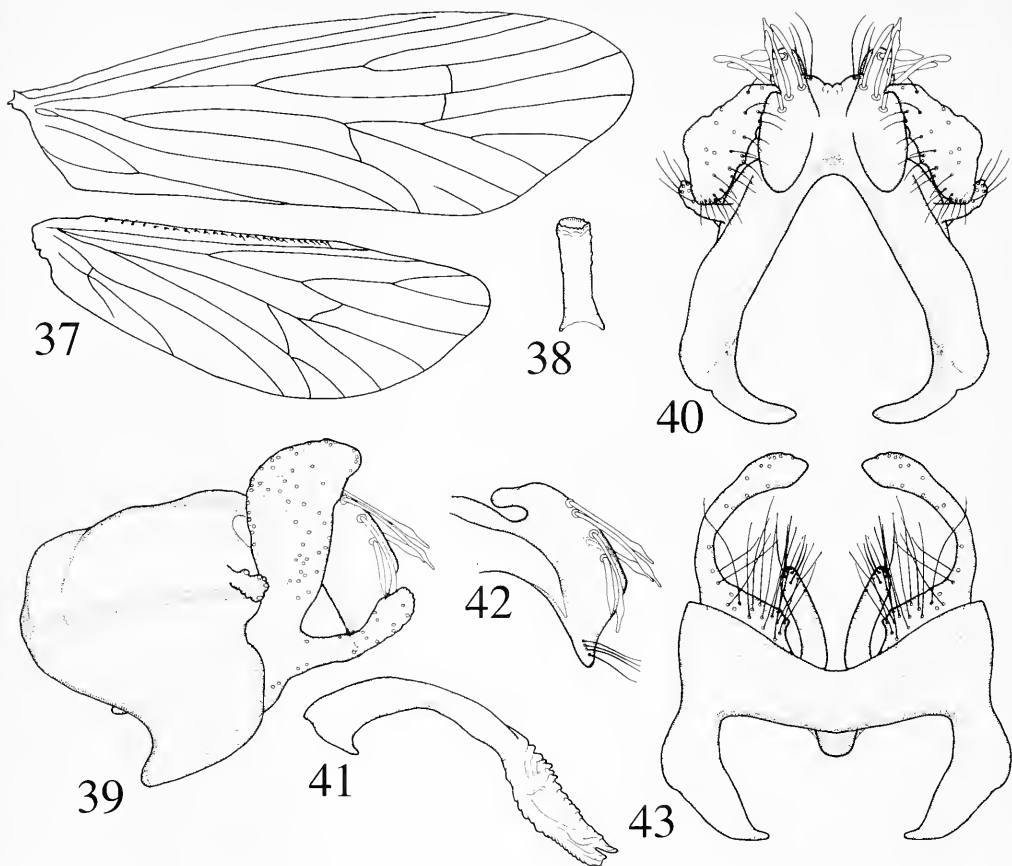
*H. browni* sp. n. males can be distinguished from other *Helicopsyche* species by the rounded, and broad anteriorly produced process of segment IX (fig. 39); the substraight, slightly sigmoid posterior margin of the gonocoxal primary branch; the rounded anterodorsal margin (fig. 39); the acute angled primary and secondary branches (fig. 39); and the about twelve drop shaped Xth tergal megasetae (figs. 40, 42).

**Etymology**

*H. browni*, named after one of the collectors, R. Brown.

**Description**

Male. – Head maxillary palp joints equally long. Scape as long as basal joint of maxillary palp; with 54 flagellomeres. Cephalic warts pyriform, strongly extended towards anterior head margin. Wings (fig. 37): fore wing 6.0 mm; fork 1 originates about midway on Dc; Dc about 2.5× longer than M<sub>2</sub>; M<sub>2</sub> 1.6× longer than distal part of M<sub>2+3</sub>; Cu<sub>1a</sub> basally faded; crossvein Cu<sub>1</sub>-Cu<sub>2</sub> apparently absent. Hind wing 4.3 mm; with 27 hamuli; R<sub>2</sub> slightly shorter than R<sub>2+3</sub>; crossvein M-Cu meets Cu at some distance basally to fork 5; brush of long, black setae and scaloid setae absent. Fore leg posterior spur about 0.5× anterior spur length. Abdomen with well developed VIth sternal process (fig. 38). Genitalia (figs. 39–43): IXth segment produced anteriorly into a rounded process (fig. 39); submarginal apodeme present (fig. 39); IXth sternal incision wide and deep (fig. 39). Superior appendage directed posteroventrad, originates near dorsal margin of lateral apodeme. Xth tergum, lateral view (figs. 39, 42), strongly produces dorsad and expands into anterior lobe (fig. 42). Xth tergal megasetae arranged into a median group with three drop shaped megasetae (fig. 40), and a lateral group including two drop and tube shaped megasetae and a distal thick, drop shaped megaseta (figs. 40, 42). Distal part of Xth tergum generally wide, tapers strongly near apex (fig. 42). Gonocoxite, lateral view (fig. 39), with primary branch more than 3× broader, and



Figs. 37-43. *Helicopsyche browni* sp. n., male. – 37, right wings; 38, VIth sternal process, ventral view; 39, genitalia, lateral view; 40, genitalia, dorsal view; 41, phallus, lateral view; 42, Xth tergum, lateral view; 43, genitalia, ventral view.

slightly longer than secondary branch; slightly sigmoid. Secondary branch, ventral view (fig. 43), slender, strongly curved mediad and with slightly club shaped apex; basal part wide and produced into a small, pointed process. Basomedian branch of gonocoxite slightly broader towards apex in lateral view (fig. 39), but parallel shaped and curved laterad in ventral view (fig. 43). Basal plate (fig. 43) anteriorly broad, with rounded apex. Phallus (fig. 41) without sclerous processes; curved ventrad along its length.

Female, larva, pupa. – Unknown.

*Helicopsyche baroua* sp. n.  
(figs. 44-50)

#### Type material

Holotype, ♂ (in alcohol), NEW CALEDONIA: Mt.

Stream up Boulari River, 3.ix.1958, light trap (C. R. Joyce) (BMH).

Paratype, ♂ pupa (in alcohol), NEW CALEDONIA: Baroua River, between Bouail and Poyabei bridge Terr. Rte. 1, 1.viii.1965 (F. Starmuhlner) (ROM).

#### Diagnosis

*H. baroua* sp. n. can be distinguished from other *Helicopsyche* species by the dorsally pointed IXth segment (fig. 45); rounded expansion of the Xth segment (figs. 45, 46, 49); long lateral processes which originates basolaterally on the Xth tergum (figs. 46, 49); the sickle shaped gonocoxal primary branch (fig. 45); the pair of dorsad, hook shaped apical; and the ventrad hook shaped subapical sclerous phallic processes (fig. 48).

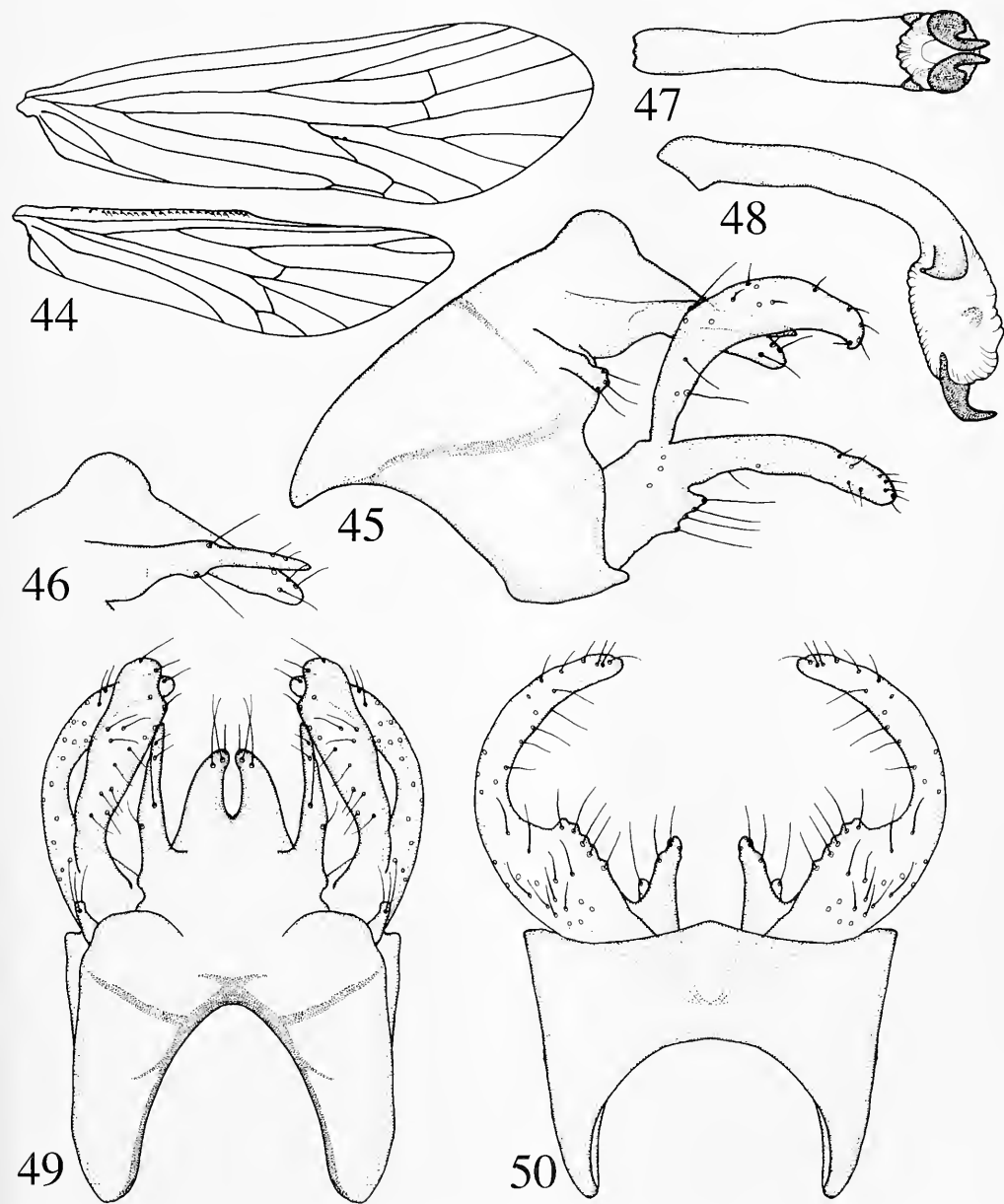
# **Etymology**

*H. baroua*, from Baroua River, the type locality.

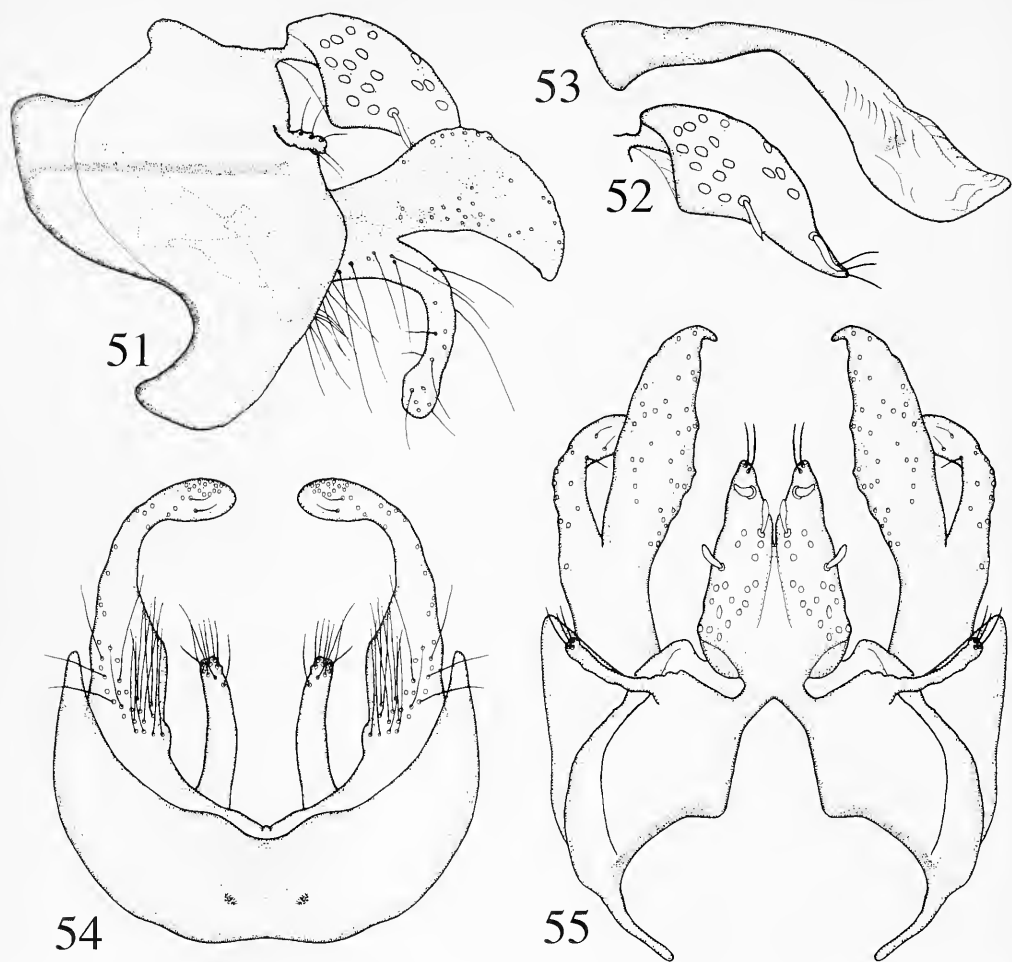
# **Description**

Male. — Head: maxillary palp joints equally long;

scape slightly longer than joints of maxillary palp; flagella broken; cephalic warts pyriform. Wings (fig. 44): fore wing 3.8 mm; fork 1 originates about medially on dc; Dc nearly 2× longer than  $M_2$ ;  $M_2$  about 1.5× longer than  $M_{1+2}$ ;  $Cu_{1a}$  and  $Cu_{1b}$  present;



Figs. 44-50. *Helicopsyche baroua* sp. n., male. — 44, genitalia, lateral view; 46, Xth tergum, lateral view; 47, phallus, ventral view; 48, phallus, lateral view; 49, genitalia, dorsal view; 50, genitalia, ventral view.

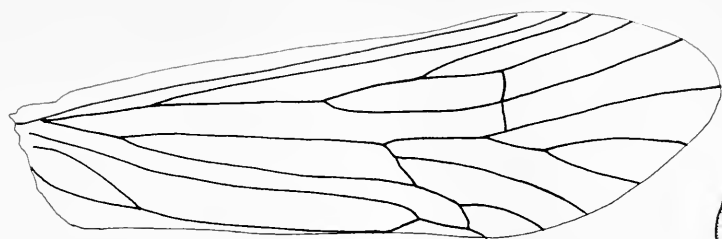


Figs. 51-55. *Helicopsyche ouaroua* sp. n., male. – 51, genitalia, lateral view; 52, Xth tergum, lateral view; 53, phallus, lateral view; 54, genitalia, ventral view; 55, genitalia, dorsal view.

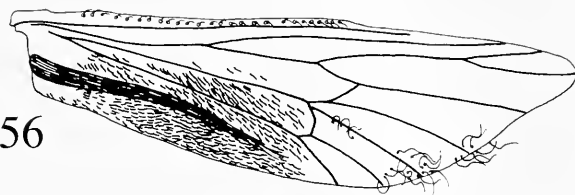
crossvein  $Cu_1-Cu_2$  present. Hind wing 2.9 mm; with 24 hamuli;  $R_{2+3}$  about  $2\times$  longer than  $R_2$ ; crossvein M-Cu meets Cu well into  $Cu_1$ ; anal setae brush and scaloid setae absent. Fore leg posterior spur length about  $\frac{1}{3}\times$  anterior spur length. Genitalia (figs. 45-50): IXth segment strongly produced and tapers anteriorly, slightly curved ventrad (fig. 45); dorsal margin substraight (fig. 45); anteroventral margin concave (fig. 45); submarginal apodeme absent. Sternal incision absent. Superior appendage tuboid, oriented posteroventrad (fig. 45); originates at some distance

dorsal to lateral apodeme. Xth tergum, lateral view (figs. 45, 46) with dorsobasal, rounded process; distal half tapers slightly towards apex; megasetae absent; setae present on apex. In dorsal view (fig. 49), basally broad but tapers slightly towards apex; the two apical lobes converge. A second pair of processes originate from basal part are oriented posteriad, substraight, and with dorsal and lateral setae (figs. 46, 49). Gonocoxite, lateral view (fig. 45) with broad base; diverges into two equally long and thick primary and secondary branches; primary branch sickle shaped; sec-

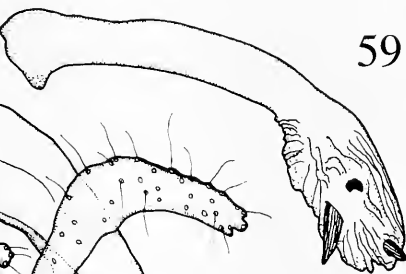
Figs. 56-61. *Helicopsyche fusca* sp. n., male. – 56, right wings; 57, genitalia, lateral view; 58, phallus, lateral view; 59, phallus, dorsal view; 60, genitalia, dorsal view; 61, genitalia, ventral view.



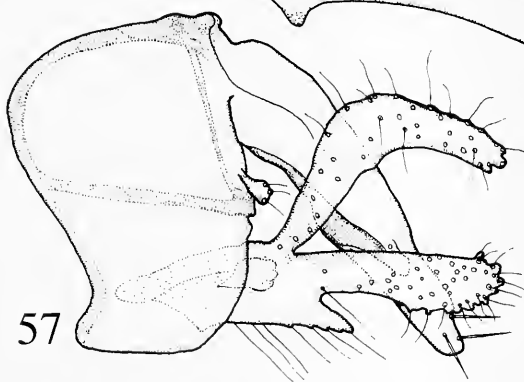
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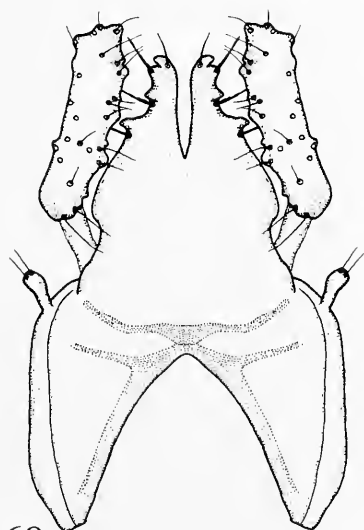
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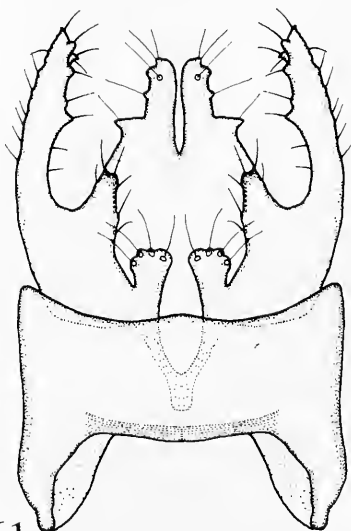
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61

ondary branch slightly curved ventrad; in ventral view (fig. 50) with strongly mediad curved secondary branches; basal part wide and produced into short processes with undulated median margins. Basomedian branch trianguloid (fig. 50); with strongly erected seta base on middle part (fig. 50). Basal plate short, rounded (fig. 50). Phallus with two pairs of sclerous processes: a pair of short, broad downwardly hooked subapical process (fig. 47), and a pair of slightly longer, upwardly hooked apical process (figs. 47, 48); in ventral view (fig. 47), with distal part slightly broader than basal half.

Female and larva. – Unknown.

***Helicopsyche ouaroua* sp. n.**  
(figs. 51-55)

**Type material**

Holotype, ♂ pupa (in alcohol), NEW CALEDONIA: Ouarou River source of Tchamba River, N of Ponérihouen, 25.viii.1965 (F. Starmuhlner) (79/2) (EOM). Paratype, ♂ (in alcohol), NEW CALEDONIA: Mt. Panié, 30m, near stream at base, 30.x.1986, UV trap (R. Brown & O. Pellmyr) (NMNH).

**Diagnosis**

*H. ouaroua* sp. n. is distinguished from other *Helicopsyche* species by the slightly tapering anterodorsal process of the IXth segment (fig. 51); the dorsomedian process of the IXth tergite (figs. 51, 55); the ventrally expanded Xth tergum (figs. 51, 52); and the short Xth tergal megasetae (figs. 51, 52, 55).

**Etymology**

*H. ouaroua*, after Ouarou River, the type locality.

**Description**

Male. – Head and wings unknown. Genitalia (figs. 51-55): IXth segment strongly produced anteriorly into a rectangle (fig. 51); submarginal apodeme present (fig. 51); dorsal margin (fig. 51) projected dorsally into a rounded lobe, also seen in dorsal view (fig. 55); sternal incision deep and wide (fig. 51). Superior appendage originates from posterior margin (figs. 51, 55); oriented laterally (fig. 55) and tuboid. Xth tergum basally incised, widens strongly into a dorsal and a ventral projection (figs. 51, 52); tapers gently towards apex; few apical setae; about 21 pairs of very short megasetae present on lateral faces (figs. 51, 52, 55). Gonocoxite with sickle shaped primary branch about 4× broader than secondary branch (fig. 51); secondary branch curved ventrad (fig. 51); in ventral view with broad base without prominent median process (fig. 54). Basomedian processes tuboid, tapers slightly toward apex, and divergent (fig. 54); club

shaped in lateral view (fig. 51). Basal plate long, apparently with bifurcated anterior apex (fig. 54). Phallus (fig. 53) medially bent ventrad.

Female, larva and pupa. – Unknown.

***Helicopsyche fusca* sp. n.**  
(figs. 56-61)

**Type material**

Holotype, ♂ (in Canada balsam), NEW CALEDONIA: Mt. Koghi, 400m, 12-14.xi.1986, UV trap (R. Brown & O. Pellmyr) (NMNH).

Paratypes, 4♂ (in alcohol), as holotype.

**Diagnosis**

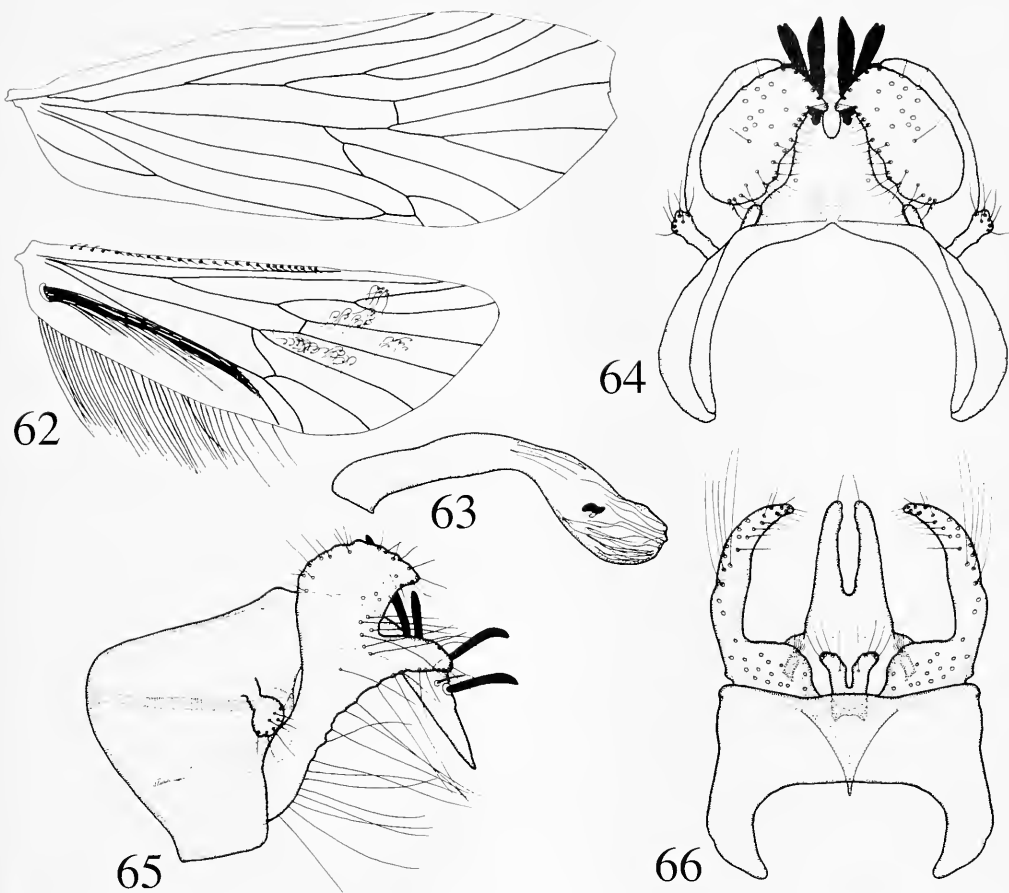
*H. fusca* sp. n. can be distinguished from other *Helicopsyche* species by the hind wing having a brush of long, dark setae in anal area, scaloid setae in anal area, cubital area and basal half median area, and long, curled setae in distal median and cubital area (fig. 56); the laterally expanded Xth tergum (fig. 60), the trianguloid basal process and the short, club shaped basomedian processes (fig. 61); and phallus with a very short, pointed apical, and longer, pointed subapical sclerous processes (fig. 58).

**Etymology**

*H. fusca*, from Latin, fuscus, dark, refers to the darkly pigmented body and wings of the species.

**Description**

Male. – Head: maxillary palp with basal joint longer than distal joint. Scape slightly longer than joint of basal maxillary palp; flagella broken. Cephalic warts strongly pyriform, nearly reach anterior head margin. Fore leg posterior spur about 0.5× anterior spur length. Wings (fig. 56): Fore wing 4.3 mm; fork 1 originates medially on Dc; Dc nearly 2× longer than M<sub>3</sub>; M<sub>2</sub> about 1.6× longer than distal part of M<sub>1+2</sub>; crossvein M-Cu<sub>1</sub> meets Cu<sub>1</sub> at some distance before bifurcation into fork 5, the distance is slightly longer than Cu<sub>1b</sub> length; crossvein Cu<sub>1</sub>-Cu<sub>2</sub> present. Hind wing 3.4 mm; 26 hamuli; crossvein M-Cu meets Cu<sub>1</sub> on fork 5; R<sub>5</sub> about half as long as R<sub>2+3</sub>. Brush of long, dark setae originates basally in anal area. Scaloid setae are present on a large area covering anal and basal 4/5 cubital area. Long curled setae are present on the distal part of M-area. Genitalia (figs. 57-61): IXth segment anteriorly rounded (fig. 57); submarginal apodeme absent; sternal incision wide, not deep (fig. 57). Superior appendage originates dorsally to lateral apodeme, short, directed posteriad (figs. 57, 60). Xth tergum basally broad, tapers slightly towards apex; without megasetae; expands laterally



Figs. 62-66. *Helicopsyche penicilla* sp. n., male. – 62, right wings; 63, phallus, lateral view; 64, genitalia, dorsal view; 65, genitalia, lateral view; 66, genitalia, ventral view.

into basally rounded and distally pointed, sclerotized ridges (figs. 57, 60, 61). Gonocoxal primary branch slender, sickle shaped. Secondary branch substraight and distally dilated (fig. 57); basally broad and expanded into a posteriad process (figs. 57, 61). Basomedian branches short, club shaped. Basal plate short, slender, anteriorly rounded (fig. 61). Phallus substraight; distally slightly bent ventrad (fig. 58); basally slender and swells towards apex (fig. 59); endotheca with two pairs processes (fig. 58).

Female and larva. – Unknown.

***Helicopsyche penicilla* sp. n.**  
(figs. 62-66)

**Type material**

Holotype, ♂ (in alcohol), NEW CALEDONIA: Mé Ori, 550m, 165°40'25"E, 21°32'30"S, 21.x.1986, UV trap, (R. Brown & O. Pellmyr) (NMNH).

**Diagnosis**

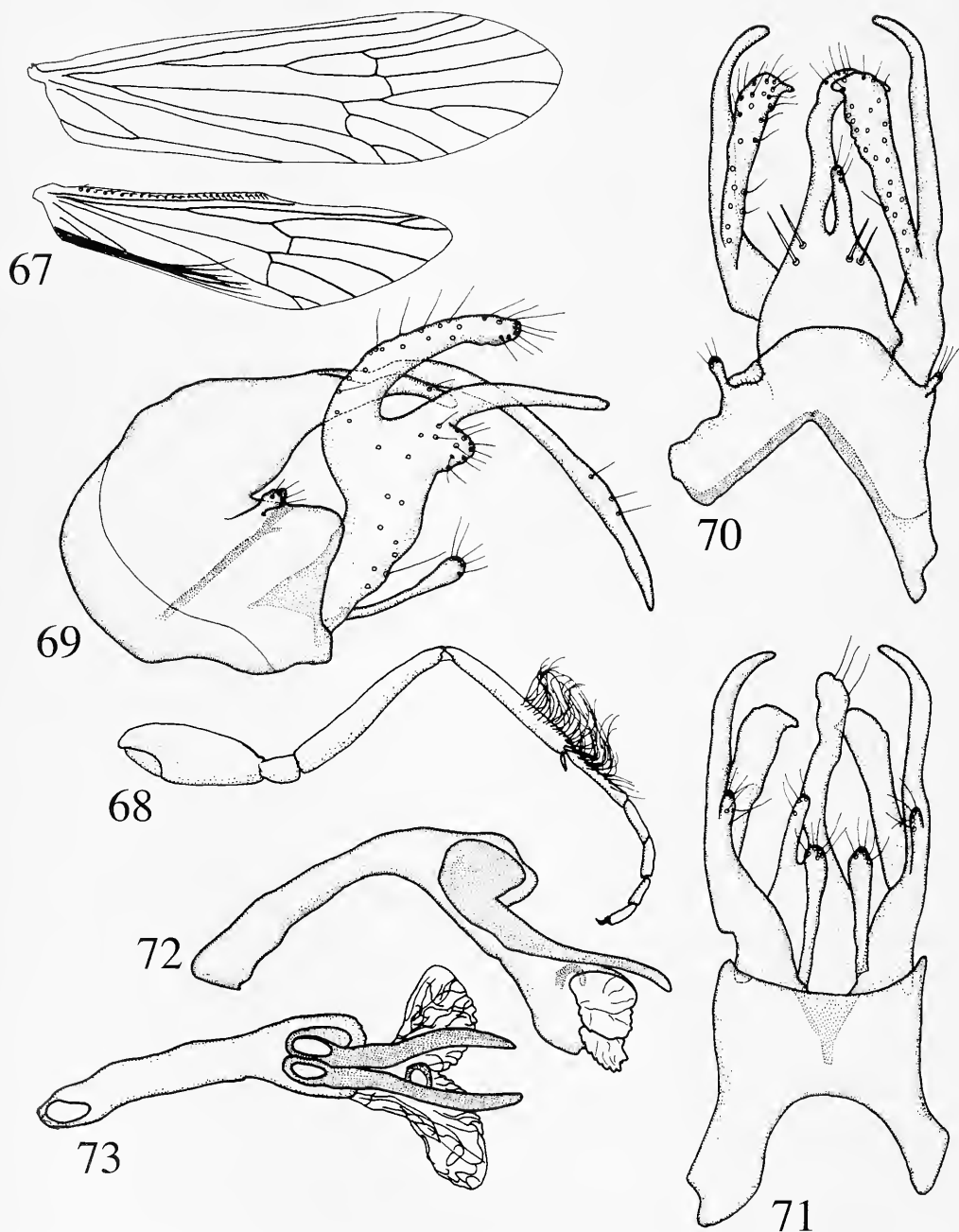
*H. penicilla* sp. n. can be distinguished from other *Helicopsyche* species by having hind wing with a brush of long, dark, anal setae, and a group of long, curled setae in the radial and median area (fig. 62); the Xth tergum which includes four pairs of very long, dark tuboid setae originating from the mid part of the segment (figs. 65, 64); the short gonocoxal basomedian branches which are basally fused into a common plate (fig. 66); and the short, posteriorly oriented processes on the dorsal part, basally on the gonocoxite (fig. 66).

**Etymology**

*H. penicilla*, from Latin, penicillus, brush, refers to the modified wing setae.

**Description**

Male. – Head: maxillary palp joints equally long.



Figs. 67-73. *Helicopsyche tenuisa* sp. n., male. – 67, right wings; 68, right fore leg, posterior view; 69, genitalia, lateral view; 70, genitalia, dorsal view; 71, genitalia, ventral view; 72, phallus, lateral view; 73, phallus, dorsal view.

Antenna with scape slightly longer than basal joint of maxillary palp; 44 flagellomeres, each with a ring of scaloid setae. Cephalic warts bean shaped, with grey median lamella covering base formed by long, dark setae. Fore leg posterior spur about  $\frac{1}{3} \times$  anterior spur. Wings (fig. 62): Fore wing 5.1 mm; crossvein  $R_5-R_4$  absent;  $M_1$  slightly longer than  $2 \times$  distal part of  $M_{1+2}$ ; crossvein M-Cu meets  $Cu_1$  at some distance basally to bifurcation, the distance is about  $1.6 \times$  longer than  $Cu_{1b}$  length. Hind wing 4.1 mm; 26 hamuli; crossvein M-Cu fuses with  $Cu_1$  on fork 5;  $R_2$  about  $1.5 \times$  longer than  $R_{2+3}$ . Anal area with brush of long, blackish setae; long curled setae present on distal half; posterior margin with row of very long setae. Genitalia (figs. 63-66): IXth segment expanded anteriorly (fig. 65); submarginal apodeme absent; dorsal margin substraight (fig. 65); sternal incision absent; in dorsal view (fig. 64), widely divided. Superior appendage strongly club shaped (fig. 65); originates close to lateral apodeme and directed posteroventral. Xth tergum slender and tapers towards apex (fig. 65); with four pairs long, tuboid, blackish megasetae (figs. 64, 65); apex cleaved halfway toward base (fig. 66). Gonocoxite divides at distal half into a broad, short and posteriorly curved primary branch and a short, slender, substraight secondary branch (fig. 65). Primary branch curves medially and covers Xth tergum. Basal part expanded into rounded process (fig. 66). Basomedian branches fuse basally, short and slightly curved laterally towards apex (fig. 66). Additional pair of small processes present dorsally on gonocoxal base (fig. 66). Basal plate long, tapering and with pointed anterior apex (fig. 66). Phallus (fig. 63) basally and distally substraight; bent ventrad about midway.

Female, larva and pupa. – Unknown.

*Helicopsyche tenuisa* sp. n.  
(figs. 67-73)

#### Type material

Holotype, ♂ (in Canada balsam), NEW CALEDONIA: Rivière Bleue, 166°37'53"E, 25°5'30"S, 8.xi.1986, UV trap (R. Brown & O. Pellmyr) (NMNH).

Paratypes, 3♂ (in alcohol), as holotype (NMNH).

#### Diagnosis

*H. tenuisa* sp. n. can be distinguished from other *Helicopsyche* species by a row of long, dark setae present on the fore leg tibia and first tarsal joint (fig. 68); the asymmetrical, slender Xth tergum (figs. 69-71); the two pairs of basal and three pairs of distal Xth tergal setae (figs. 69, 70); the gonocoxal secondary branch (fig. 69) with a large ventral process; the sick-

le shaped primary branch of gonocoxite (fig. 69); the long, slender basomedian branch of gonocoxite (figs. 69, 71); and the very long phallic sclerous processes (figs. 72, 73).

#### Etymology

*H. tenuisa*, from Latin, *tenuis*, thin, slender, refers to the shape of the genitalic structures Xth tergum and gonocoxal primary, secondary and basomedian branches.

#### Description

Male. – Head: Maxillary palp basal joint longer than distal joint. Antenna with scape as long as basal joint of maxillary palp; with 36 flagellomeres. Cephalic warts large, pyriform and projected towards the anterior head margin. Wings (fig. 67): Fore wing 3.2 mm; fork 1 originates distally on Dc; Dc about  $1.4 \times$  longer than  $M_2$ ;  $M_2$  about  $1.4 \times$  longer than distal part of  $M_{1+2}$ ; crossvein M-Cu meets  $Cu_1$  at some distance basally to bifurcation of  $Cu_1$ , the distance being equal to  $Cu_{1b}$  length; crossvein  $Cu_1-Cu_2$  absent. Hind wing 2.6 mm; with 27 hamuli; crossvein M-Cu meets  $Cu_1$  at long distance before fork 5;  $R_2$  nearly half as long as  $R_{2+3}$ ; group of long, dark setae originates from anal area. Posterior spur of fore leg about  $\frac{1}{3} \times$  anterior spur; dorsal margin of tibia and 1<sup>st</sup> tarsal segment with dense, long, dark setae in row (fig. 68). VIth sternal process absent. Genitalia (figs. 69-73): IXth segment rounded anteriorly (fig. 69); asymmetrical (figs. 70, 71); submarginal apodeme apparently present on left half (fig. 69); sternal incision absent. Superior appendage, short, club shaped, originates close to lateral apodeme (figs. 69, 70). Xth tergum asymmetrical, with right side about  $3 \times$  longer than left side (figs. 69, 70, 71); slightly curved ventrad along its length (fig. 69); without megasetae; with two pairs of basal setae and about three pairs of apical setae (figs. 69, 70); apex rounded (fig. 71). Gonocoxite with slender primary and secondary branches (fig. 69); primary branch about  $2 \times$  broader than secondary branch (fig. 69); in lateral view slightly curved posteriad. Basal process broad, rounded in lateral view (fig. 69), slender in ventral view (fig. 71), originates basiventrally on secondary branch (fig. 69). Basomedian branch long, slender, club shaped and substraight (figs. 69, 71). Basal plate short; anteriorly thin and with rounded apex (fig. 71). Phallus basally and distally substraight, mid part bent ventrad (fig. 72); basal part thinner than distal part (fig. 73); with a pair of very long, basally broad and distally slender sclerous processes (figs. 72, 73).

Female, larva and pupa. – Unknown.

*H. patriciae* sp. n.  
(figs. 74-78)

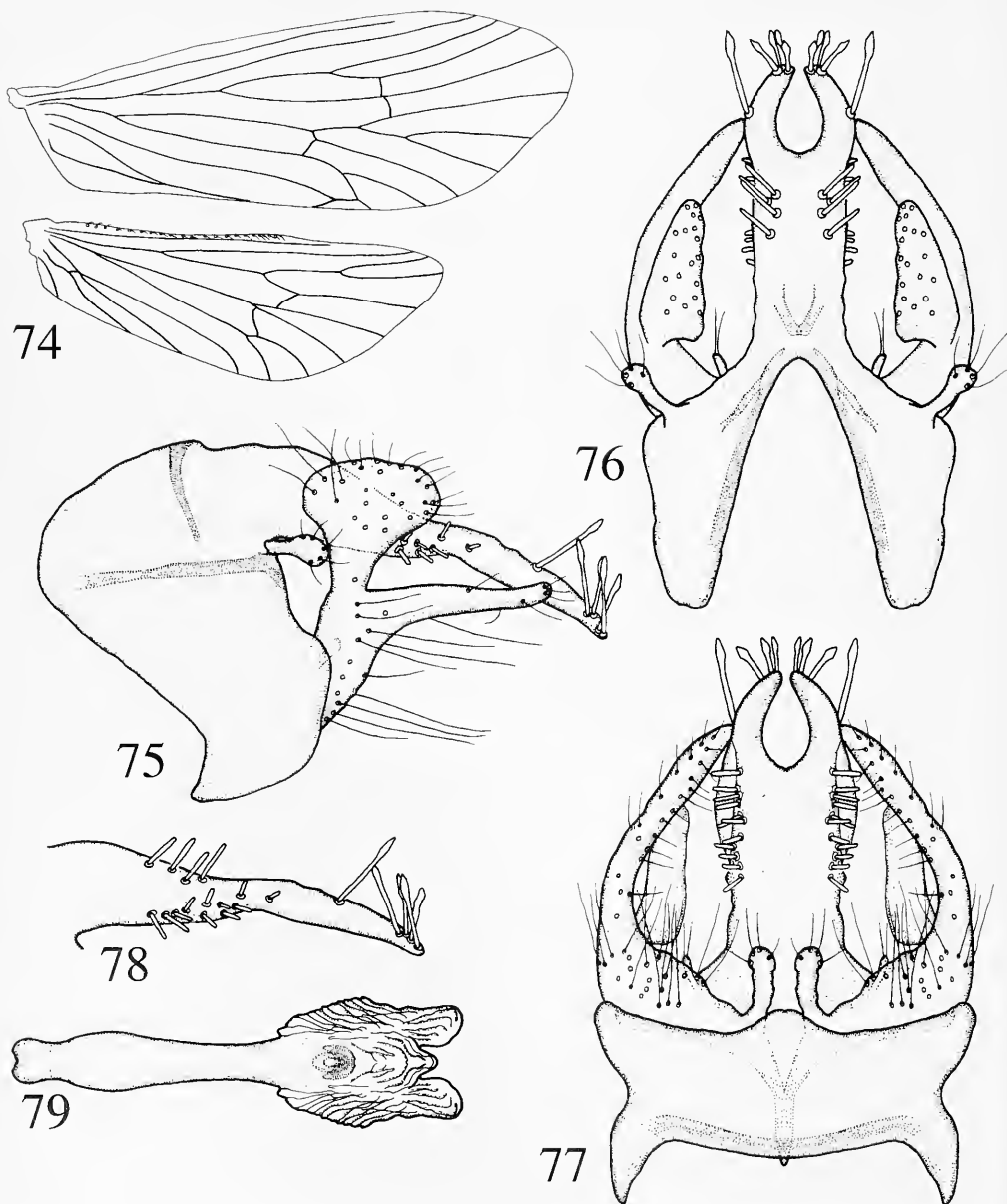
**Type material**

Holotype, ♂ (in alcohol), NEW CALEDONIA: 5 km S Touho, 100m, Panandou River, 165°13'E,

20°49'S, 2.ii.1984 (M. Pogue & M. Epstein)  
(NMNH).

**Diagnosis**

*H. patriciae* sp. n. can be distinguished from other *Helicopsyche* species by the ovoid gonocoxal primary



Figs. 74-79. *Helicopsyche patriciae* sp. n., male. – 74, right wings; 75, genitalia, lateral view; 76, genitalia, dorsal view; 77, genitalia, ventral view; 78, Xth tergum, lateral view; 79, phallus, dorsal view.

branch (fig. 75); the long Xth tergum which has central rows of short, tuboid megasetae and apical, drop shaped megasetae (figs. 75, 76, 77); and a pair of tiny additional process originating dorsally on the basal part of the gonocoxite (figs. 75, 76, 77).

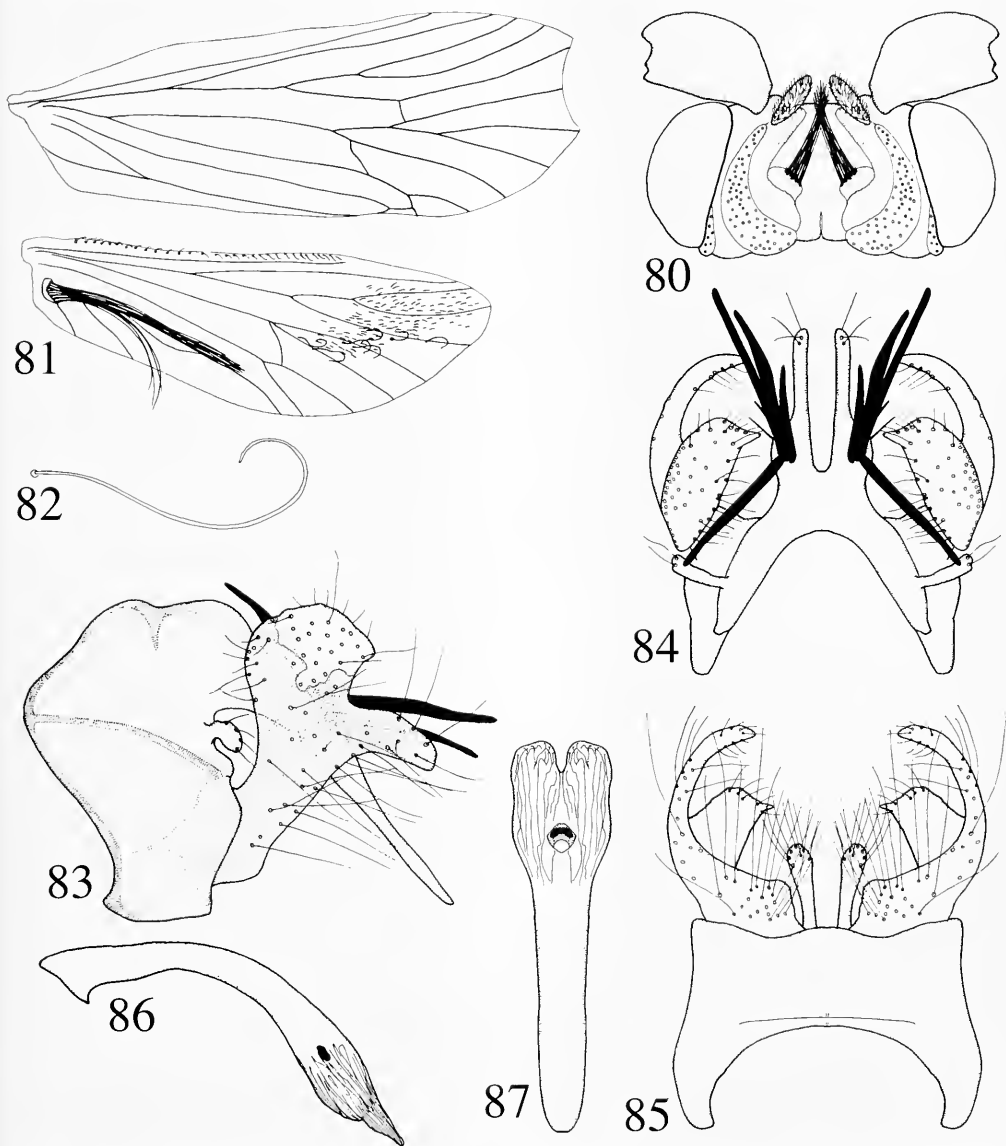
### Etymology

*H. patriciae*, named after Mrs. Patricia W. Scheffer

in recognition of her enthusiasm for NEW CALEDONIAN *Helicopsyche*.

### Description

Male. — Head maxillary palp joints about equally long. Antenna: scape about as long as basal joint of maxillary palp; with 42 flagellomeres. Cephalic warts strongly pyriform, reach anterior head margin. Fore



Figs. 80-87. *Helicopsyche nigrospinosus* sp. n., male. — 80, head, dorsal view; 81, right wings; 82, curled seta from hind wing, highly magnified; 83, genitalia, lateral view; 84, genitalia, dorsal view; 85, genitalia, ventral view; 86, phallus, lateral view; 87, phallus, ventral view.

leg posterior spur length about half anterior spur length. Wings (fig. 74): Fore wing 4.6 mm; fork 1 originates distally on Dc; Dc about  $1.6 \times$  longer than  $M_2$ ;  $M_2$  about  $2 \times$  longer than distal part of  $M_{1+2}$ ; crossvein M-Cu meets  $Cu_1$  at some distance before bifurcation of  $Cu_1$ , the distance being about as long as  $Cu_{1b}$ ; crossvein  $Cu_1$ - $Cu_2$  present. Hind wing 3.5 mm; with 22 hamuli; crossvein M-Cu meets basal part of fork 5;  $R_2$  slightly longer than  $R_{2+3}$ . Modified setae absent. VIth sternal process well developed. Genitalia (figs. 75-78): IXth segment anteriorly hyperbeloid; without submarginal apodeme; sternal incision wide, not deep. Superior appendage originates close to lateral apodeme (fig. 75); directed postero-laterad, club shaped. Xth tergum substraight, slender in lateral view (fig. 75), broad in ventral and dorsal views (figs. 76, 77); with about eleven pairs of short megasetae arranged in ventrolateral row (fig. 77); three pairs of long, tuboid megasetae form a row midway on segment (fig. 76); a pair of long dorsal, posterodorsad, drop shaped preapical megasetae (figs. 75, 77); a group of four drop shaped, long apical megasetae (figs. 75, 76, 77). Gonocoxite with short, apically subcircular primary branch, and long, thin and substraight secondary branch (fig. 75). Broad basal part without projections but with a pair of very small processes originating from dorsal face (figs. 75, 77). Basomedian branches medially long, tuboid and substraight (fig. 77). Basal plate anteriorly produced, slender, pointed. Phallus (fig. 78) substraight, with basal part slightly swollen; without sclerous processes.

Female, larva and pupa. – Unknown.

***Helicopsyche nigrospinosa* sp. n.**  
(figs. 80-87)

**Type material**

Holotype, ♂ (in alcohol), NEW CALEDONIA: Mt. Koghi, 400m, 12-14.xi.1986, UV trap (R. Brown & O. Pellmyr) (NMNH).

**Diagnosis**

*H. nigrospinosa* sp. n. can be distinguished from other *Helicopsyche* species by the hind wing setae which include a brush of long, dark setae in the anal area; long curled setae in  $R_5$ - and distal part of the M-sectors and small scaloid setae in the distal part of the radial and median sectors (fig. 81); the dorsally produced IXth tergal margin (fig. 83); the laterally expanded Xth tergum (fig. 84); the elongate and strongly tapering Xth tergum (fig. 83); and the long, club shaped gonocoxal basomedian branches (fig. 85).

**Etymology**

*H. nigrospinosa*, from Latin, nigro, blackish, spinosus, thorny, refers to the long, dark Xth tergal megasetae.

**Description**

Male. – Head (fig. 80): Maxillary palp joints equally long. Antenna: scape as long as basal joint of maxillary palp; flagella broken. Cephalic wart sickle shaped, elongated anteriorly; grey curved lamella originates from median part of cephalic warts; grey process with long, dark setae present between the grey lamellae. Interantennal warts present, covered by short setae. Posterior spur length of fore leg about half of anterior spur length. Wings (figs. 81, 82): Fore wing 5.0 mm; crossvein  $R_2$ - $R_3$  absent;  $M_2$  about  $2.6 \times$  longer than distal part of  $M_{1+2}$ ; Crossvein M-Cu meets  $Cu_1$  at some distance basally to fork 5, the distance is about  $2 \times$   $Cu_{1b}$  length. Hind wing 4.1 mm; with 31 hamuli; crossvein M-Cu fuses with fork 5;  $R_2$  nearly  $1.9 \times$  longer than  $R_{2+3}$ . Anal area with brush of long, dark setae. Short lamelloid and long, thin curled setae (fig. 82) present on distal half. VIth sternal process large. Genitalia (figs. 83-87): IXth segment anteriorly rounded (fig. 83); submarginal apodeme absent; dorsal margin with dorsal projection (fig. 83); sternal incision wide, shallow (fig. 83). Superior appendage originates at some distance dorsally to lateral apodeme tuboid, directed laterad (fig. 84). Xth tergum substraight, tapering towards apex, slender in lateral view (fig. 83); in dorsal view (fig. 84), with broad central part, apex slender and deeply divided; four pairs of long, dark, tuboid megasetae originate from dorsal central part (figs. 83, 84). Gonocoxite with basal part long and broad; divided medially into broad, anterodorsally rounded, slightly posteriorly pointed primary branch, and a broad, slightly ventrad curved secondary branch (fig. 83); slightly produced into a pair of small rounded processes (fig. 85). Basomedian branches long, club shaped, substraight (fig. 85). Basal plate long, anteriorly needle shaped (fig. 85). Phallus without sclerous processes (figs. 86, 87), slightly curved ventrad along its length (fig. 86), anterior part and posterior part equally broad (fig. 87).

Female, larva and pupa. – Unknown.

***Helicopsyche livida* sp. n.**  
(figs. 88-93, 95)

**Type material**

Holotype, ♂ (pinned), NEW CALEDONIA: Mt. Panié, 250m, 30.x.1986, Malaise trap (R. Brown & O. Pellmyr) (NMNH).

**Diagnosis**

*H. livida* sp. n. can be distinguished from other *Helicopsyche* species by the Xth tergum with a group

of long, tuboid megasetae, row of central setae, a long, lateral, tuboid, subapical megaseta, and tuboid, dorsal megasetae (figs. 89, 91, 92); the rounded gonocoxal primary branch (fig. 89); and the additional tuboid basal branches on the gonocoxite (fig. 92).

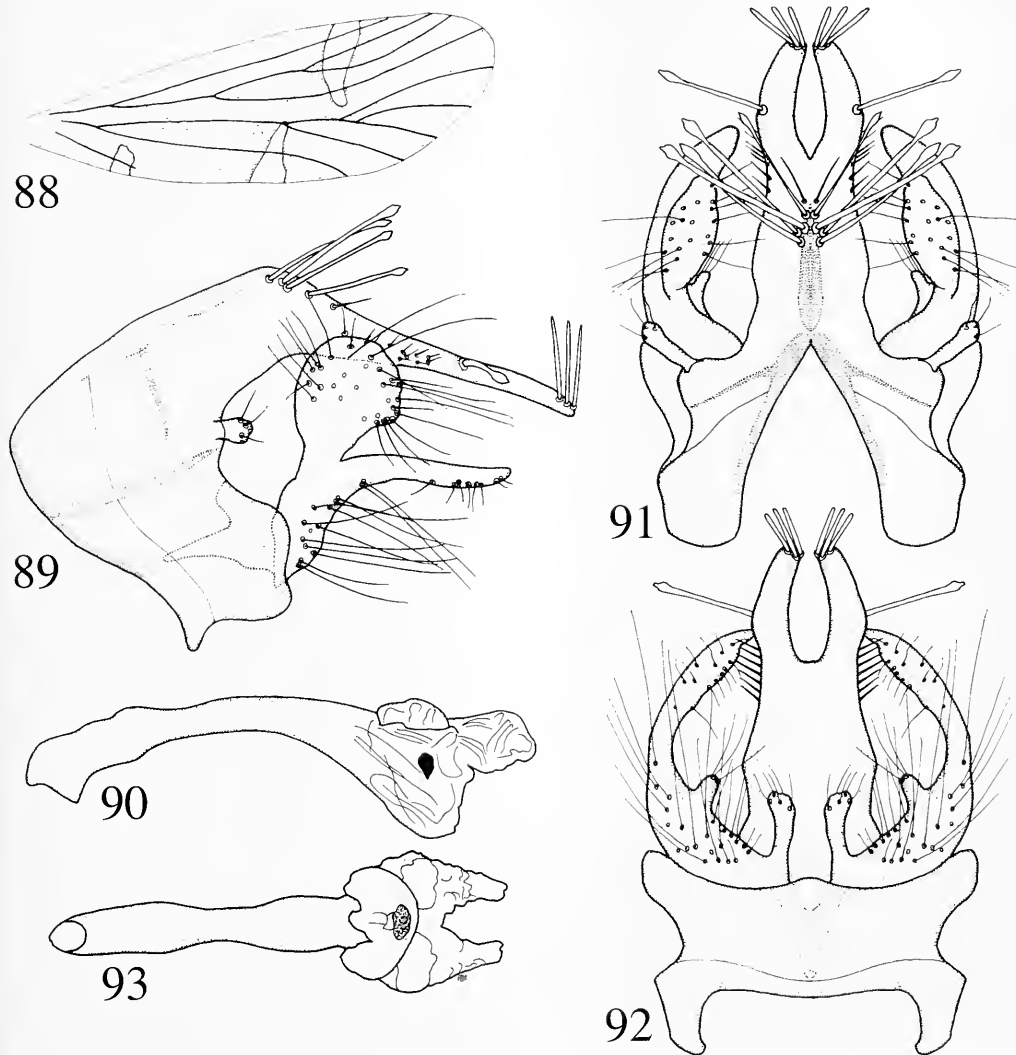
### Etymology

*H. livida*, from Latin, lividus, bluish, refers to the bluish wing spots which appearing in sunlight.

### Description

Male. — Head unknown. Fore wing (fig. 88): 5.0 mm;  $M_2$  about  $5\times$  longer than distal part of  $M_{1+2}$ .

Hind wing 3.7 mm. Fore wing dark brownish, silver blue or metallic green/purple in sunlight depending on light angle. Three whitish areas present: a band in R-section, a band crossing distal part of Cu, and a small basal spot in A-section, all being silver bluish in sunlight. Posterior wing colour grey-brownish. Genitalia (figs. 89-93): IXth segment anterior part hyperbolic, submarginal apodeme absent, but with a line running between dorsal margin of IXth tergum and ventral margin of IXth sternum (fig. 89); dorsal margin slightly convex; sternal incision small, wide; ventral sternal margin with rounded notch (fig. 89), seen



Figs. 88-93. *Helicopsyche livida* sp. n., male. — 88, right fore wing; 89, genitalia, lateral view; 90, phallus, lateral view; 91, genitalia, dorsal view; 92, genitalia, ventral view; 93, phallus, ventral view.

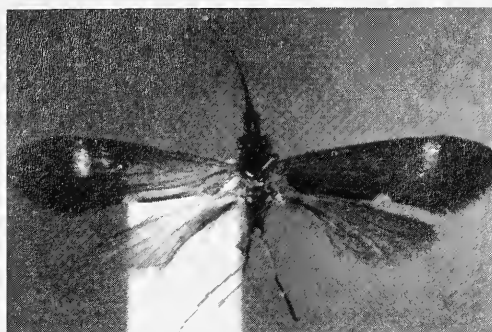


Fig. 94. *Helicopsyche arma* sp. n., male holotype, dorsal view.



Fig. 95. *Helicopsyche livida* sp. n., male holotype, lateral view.

also in dorsal and ventral views (figs. 91, 92). Superior appendage originates close to lateral apodeme (fig. 89). Xth tergum slightly tapering towards apex (fig. 88); with broad lateral undulations (figs. 91, 92); basal part with four pairs long, drop shaped megasetae; central part with short setae arranged in row; a pair of laterad and drop shaped subapical megasetae, and a group encompassing three pairs of shorter tuboid megasetae at apex. Gonocoxite with long basal part; divides into a short, rounded primary branch and a slender, substraight secondary branch (fig. 89); basal part (fig. 92) with short, tuboid process. Basomedian branches short, substraight and slightly club shaped (fig. 92). Basal plate short, tapering anteriorly (fig. 92). Phallus slightly curves ventrad; without sclerous processes; anteriorly wide; central part narrowing; posterior part as wide as anterior part (figs. 90, 93).

Female, larva and pupa. – Unknown.

***Helicopsyche rembaia* sp. n.**  
(figs. 96-101)

**Type material**

Holotype, ♂ (in Canada balsam), NEW CALEDONIA: Mt. Rembai, 750 m, 24-29.x.1981 (G. W. Gibbs) (IHPC).

**Diagnosis**

Male *H. rembaia* sp. n. is distinguished from other *Helicopsyche* species by the Xth tergum which is slender in lateral view (fig. 97); the basomedian branches that are slightly shorter than the breadth of the gonocoxal primary branches (fig. 97); the broad, substraight primary gonocoxal branches (fig. 97); and the endotheca which is produced into two dorsal, apically dark pigmented lobes (fig. 100).

**Etymology**

*H. rembai*, after the type locality.

**Description**

Male (figs. 96-101). – Head: distal joint of maxillary palp slightly longer than basal joint; scape about as long as basal joint of maxillary palp; flagella broken. Cephalic warts strongly pyriform, extended towards anterior head margin. Interantennal warts absent. Wings (fig. 96): Fore wing 4.6 mm; fork 1 originates about midway on Dc; Dc nearly 2× longer than M<sub>2</sub>; M<sub>2</sub> nearly 2× longer than distal part of M<sub>1+2</sub>; crossvein M-Cu meets Cu<sub>1</sub> at a distance before bifurcation of Cu<sub>1</sub>; Crossvein Cu<sub>1</sub>-Cu<sub>2</sub> present. Posterior wing 3.6 mm; with 28 hamuli; R<sub>2+3</sub> about 3.3× longer than R<sub>5</sub>; Crossvein M-Cu meets Cu<sub>1</sub> at some distance into Cu<sub>1+2</sub>; scaloid setae and long, dark setae absent. Fore leg posterior spur length about 0.5× anterior spur length. Abdomen with VIth sternal process well developed. Genitalia (figs. 97-101): IXth segment produced anterodorsad, submarginal apodeme absent (fig. 97). IXth sternal incision wide (fig. 97). Superior appendage directed posteriorad and originates at some distance dorsally to lateral apodeme. Xth tergum, lateral view, substraight, slender (fig. 97). Xth tergal megasetae thin, forming two lateral rows. Xth tergum dorsal margin about parallel with ventral margin in lateral aspect, apex rounded (fig. 97). Gonocoxal primary branch about 2× broader than secondary branch in lateral aspect (fig. 97); substraight, with anterior and dorsal margins subparallel. Secondary branch curved mediad, apex pointed (fig. 99); basally broad, not produced medially (fig. 99). Basomedian branch, lateral view, short, slightly club-shaped (fig. 97); in ventral view, parallel sided, substraight (fig. 99). Basal plate tapers anteriorly (fig. 99). Phallus (figs 100, 101) without sclerous processes, but with a pair of dorsal membranous lobes that are darkly pigmented at apex; in ventral view, basally slender, slightly broader towards apex; curved ventrad at about half its length.

Female, larva and pupa. – Unknown.

*Helicopsyche unilobata* sp. n.  
(figs. 102-107)

**Type material**

Holotype, ♂ (in Canada balsam), NEW CALEDONIA: Forêt Thy Reserve, 21.v.1984, 150m (G. Monteith & D. Cook) (CM).

**Diagnosis**

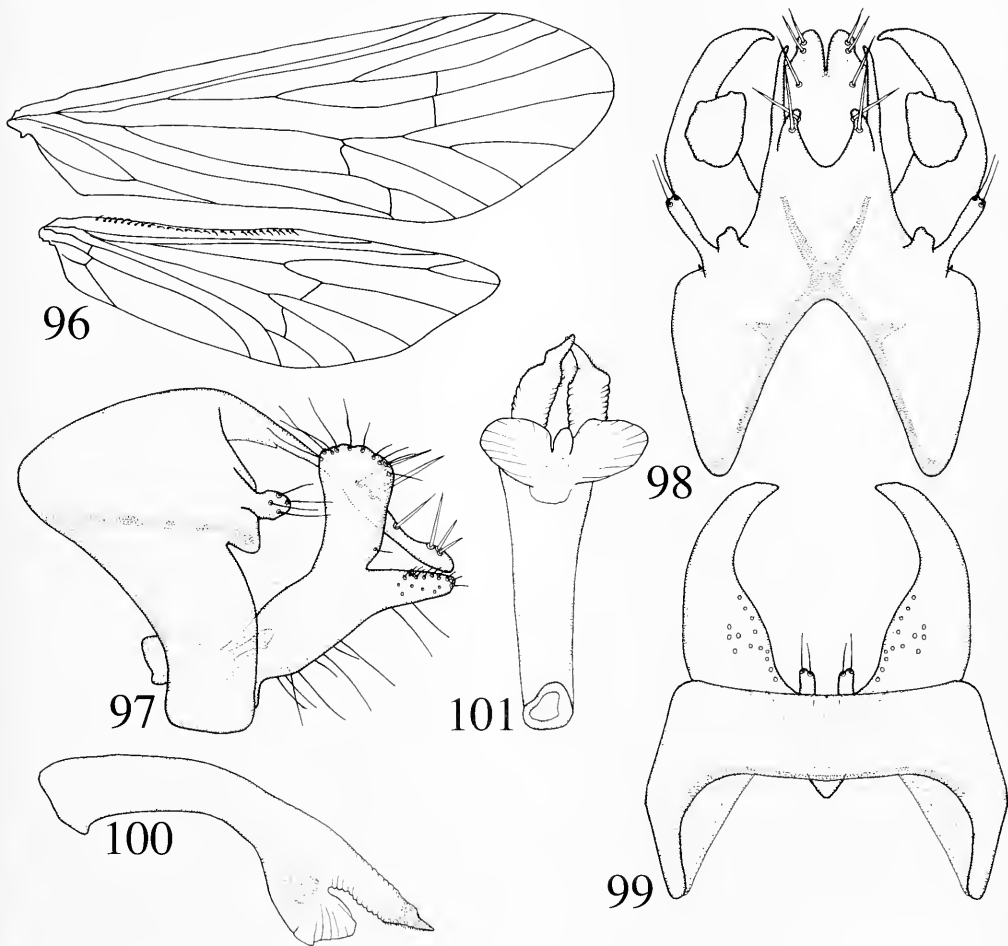
Male *H. unilobata* sp. n. is distinguished from other *Helicopsyche* species by the simple gonocoxite; the Xth tergum which is slender in lateral aspect (fig. 103), and has a hook shaped process ventrally on apex; short, slender dorsal megasetae in two groups; and the short, laterally oriented superior appendages.

**Etymology**

*H. unilobata*, after the unilobed gonocoxite.

**Description**

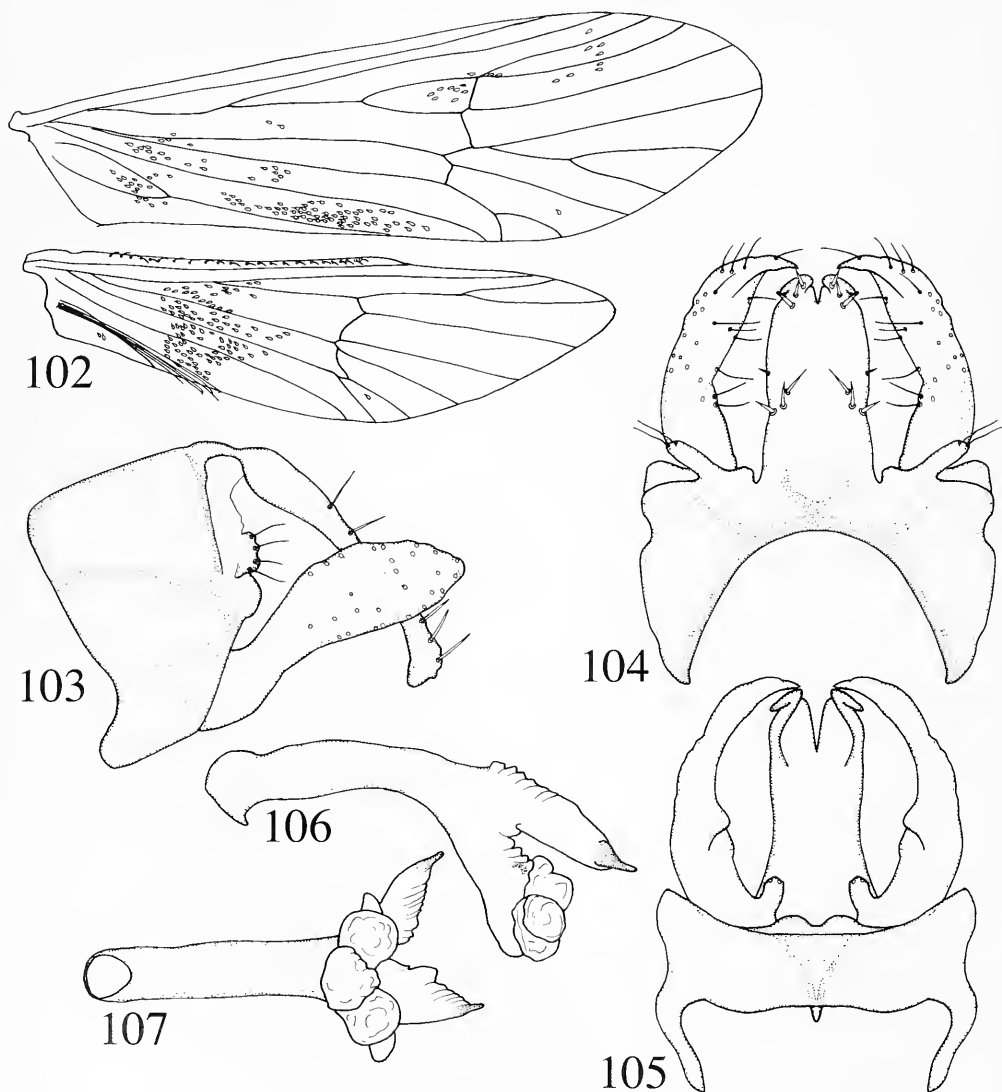
Male (figs. 102-107). – Head: joints of maxillary palp about equally long; scape about as long as basal joint of maxillary palp; flagella broken. Cephalic warts bean shaped. Interantennal warts apparently absent. Wings (fig. 102): Fore wing 4.0 mm; fork 1 originates from the distal corner of Dc; Dc about as long as  $M_2$  and distal part of  $M_{1+2}$ ; crossvein M-Cu meets  $Cu_1$  at a distance before bifurcation of  $Cu_1$ , the distance is slightly longer than the  $Cu_{1+2}$  length; Crossvein  $Cu_1$ - $Cu_2$  apparently absent. Posterior wing 3.1 mm; 24 hamuli;  $R_{2+3}$  about as long as  $R_2$ ; Crossvein M-Cu nearly tangent to point of bifurca-



Figs. 96-101. *Helicopsyche rembai* sp. n., male. – 96, right wings; 97, genitalia, lateral view; 98, genitalia, dorsal view; 99, genitalia, ventral view; 100, phallus, lateral view; 101, phallus, ventral view.

tion of Cu<sub>1</sub>; brush of long, dark anal setae present. Scaloid setae scattered over the surfaces of both fore and hind wings. Fore leg posterior spur length about  $1/2 \times$  anterior spur length. Abdomen with VIth sternal process well developed. Genitalia (figs. 103-107): IXth segment produced anterodorsad, submarginal apodeme absent (fig. 103). IXth sternal incision small and (fig. 103). Superior appendage originates at some distance dorsally to lateral apodeme and is directed laterad. Xth tergum, lateral view, slender, slightly curved ventrally (fig. 103). Xth tergal megasetae short, slen-

der, present in two groups (fig. 104). Xth tergum dorsal margin about parallel with ventral margin in lateral aspect, apex rounded in dorsal view; with hook shaped processes in ventral view (fig. 105). Gonocoxal primary branch oval in lateral view (fig. 103). Secondary branch absent (fig. 103). Basomedian branch, ventral view, short and parallel sided (fig. 103). Basal plate anteriorly tapering (fig. 105). Phallus (figs. 106, 107) without sclerous processes, but with pair of dorsal lobes with dark pigmented apex; ventral view, parallel sided; curved ventrad at about half its length.



Figs. 102-107. *Helicopsyche unilobata* sp. n., male. – 102, right wings; 103, genitalia, lateral view; 104, genitalia, dorsal view; 105, genitalia, ventral view; 106, genitalia, lateral view; 107, genitalia, ventral view.

Female, larva and pupa. – Unknown.

***Helicopsyche gibbsi* sp. n.**  
(figs. 108-114)

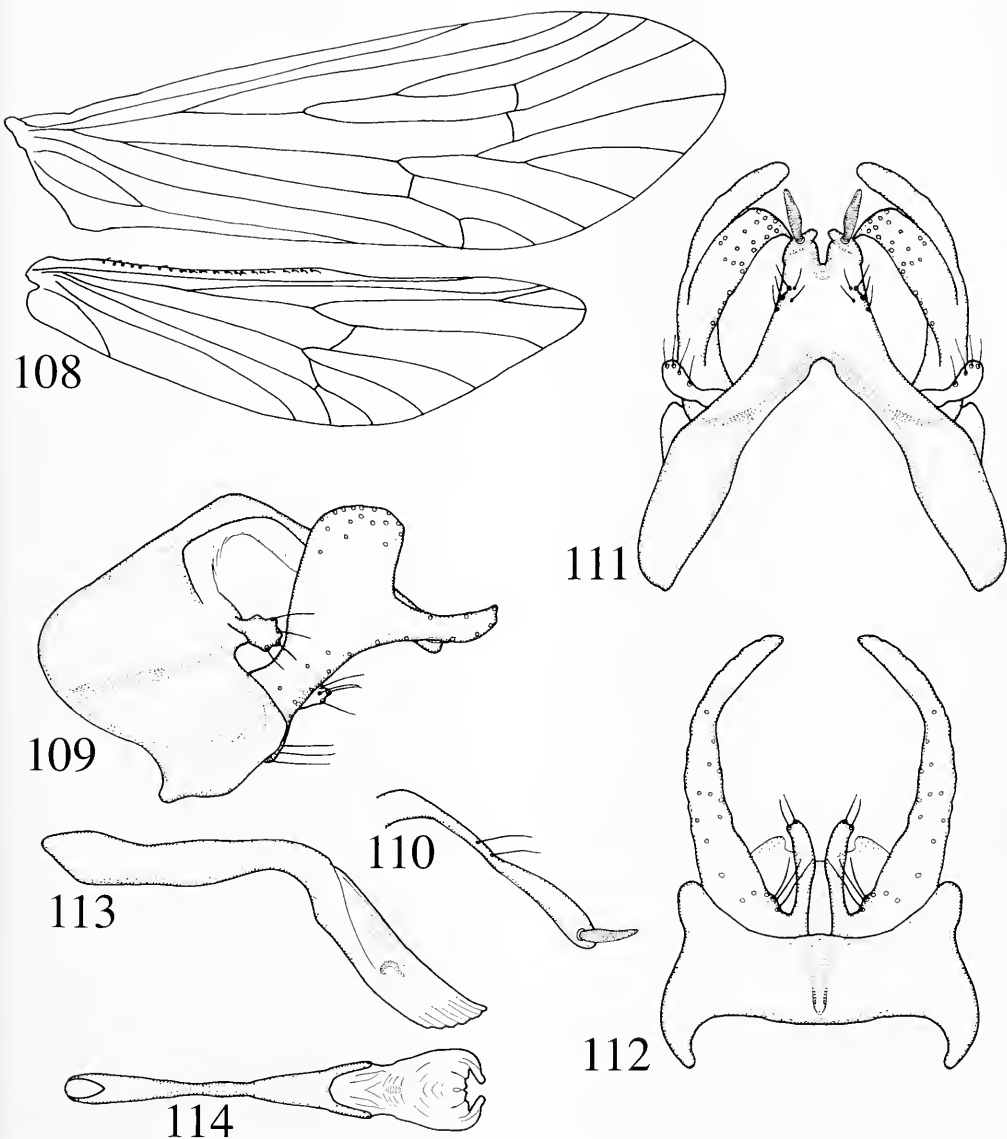
**Type material**

Holotype, ♂ (in Canada balsam), NEW CALEDONIA: Mt. Rembai, 570m, 24-29.x.1981 (G. W.

Gibbs) (IHPC). Paratype, 1 ♂ (in alcohol), NEW CALEDONIA: Mt. Rembai, 30.xi.1978 [G. W. Gibbs] (IHPC).

**Diagnosis**

Male *H. gibbsi* sp. n. are distinguished from other *Helicopsyche* species by the gonocoxite having a very broad primary branch and slender secondary branch (fig. 109); slender, substraight Xth tergum (fig. 110); single pairs of megasetae apically on the Xth tergum



Figs. 108-114. *Helicopsyche gibbsi* sp. n., male. – 108, right wings; 109, genitalia, lateral view; 110, Xth tergum, lateral view; 111, genitalia, dorsal view; 112, genitalia, ventral view; 113, phallus, lateral view; 114, phallus, ventral view.

(figs. 110-111); long, tuboid basomedian branches (fig. 112); and the laterad superior appendages (fig. 111).

### Etymology

*H. gibbsi*, after the collector, G. W. Gibbs.

### Description

Male (figs. 108-114). – Head: joints of maxillary palp equally long. Antenna: scape about as long as basal joint of maxillary palp; with 36 flagellomeres. Cephalic warts strongly pyriform, extended towards anterior head margin. Interantennal warts apparently absent. Wings (fig. 108): Fore wing 3.5 mm; fork 1 originates about midway on Dc; Dc nearly 2× longer than M<sub>2</sub>; M<sub>2</sub> about 2× longer than distal part of M<sub>1+2</sub>; crossvein M-Cu meets Cu<sub>1</sub> at a distance before bifurcation of Cu<sub>1</sub>, this distance is which is about equal to the length of Cu<sub>1</sub>; Crossvein Cu<sub>1</sub>-Cu<sub>2</sub> apparently absent. Posterior wing 2.8 mm; 21 hamuli; R<sub>2+3</sub> about 4× longer than R<sub>3</sub>; Crossvein M-Cu nearly meets point of bifurcation of Cu<sub>1</sub>; scaloid setae and brush of long, dark anal setae absent. Fore leg posterior spur length about 1/3× anterior spur length. Abdomen with VIth sternal process well developed. Genitalia (figs. 109-114): IXth segment produced anterodorsad, submarginal apodeme absent (fig. 109). IXth sternal incision small and U-shaped (fig. 109). Superior appendage originates close to lateral apodeme, oriented laterad. Xth tergum, lateral view, straight and slender (figs. 109, 110); megasetae present apically are dark and knife-shaped (figs 109, 110); dorsal margin about parallel with ventral margin, apex rounded (fig. 108). Gonocoxal primary branch about 4× broader than secondary branch in lateral view (fig. 109); substraight and dorsally rounded (fig. 109); slightly shorter than secondary branch. Secondary branch curved mediad, apex slightly rounded (fig. 109); slender basal part lack processes (fig. 112). Basomedian branch slightly club-shaped (fig. 109); in ventral view, basally parallel sided and substraight, distally bent laterad (fig. 112). Basal plate anteriorly pointed (fig. 112). Phallus (figs. 113, 114) without sclerous processes; in lateral view with basal part as broad as median part; angled ventrad at about half length.

### KEY TO NEW CALEDONIAN *HELICOPSYCHE*, MALES

For comparison with the previously described NEW CALEDONIAN *Helicopsyche* species refer to Ross (1975) and Johanson and Scheffter (1999).

1. Xth tergal megasetae absent (as in fig. 15) ..... 2
- Xth tergal megasetae present (as in fig. 7) ..... 9
2. Xth tergum simple (as in figs 7, 15) ..... 3
- Xth tergum with additional basolateral processes (figs. 20, 98) ..... 6
3. Xth tergum curves ventrally along its length in lateral view (fig. 69) ..... 4
- Xth tergum substraight in lateral view (fig. 103) ..... 5
4. Gonocoxite undivided (fig. 103); Xth tergum with more than two pairs of basal setae (fig. 104) ..... *H. unilobata* sp. n.
- Gonocoxite divides into primary and secondary branches (fig. 69); Xth tergum with two pairs of basal setae (fig. 70) ..... 27
5. Cephalic warts circuloid; postantennal warts absent; posterior wings with long curled setae on basal half (fig. 56); Xth tergum broad in dorsal and lateral view (figs. 57, 60); primary branch of gonocoxite sickle shaped in lateral view; basomedian branch of gonocoxite short (fig. 61); phallus with two pairs of small processes (fig. 58) ..... *H. fusca* sp. n.
- Cephalic warts pyriform; postantennal warts present; posterior wings without curled setae; Xth tergum slender in dorsal and lateral view; primary branch of gonocoxite slightly curved in lateral view; basomedian branch of gonocoxite long; phallus with one pair of process-like processes ..... *H. kariona* Ross
6. Xth tergum additional processes as long as, or longer than apex of Xth tergum (figs. 46, 49) ..... 7
- Xth tergum additional processes shorter than Xth tergum (figs. 20, 98) ..... 8
7. Primary branch of gonocoxite angled about 90°; posterior pair of phallic processes small ..... *H. arenaria* Ross
- Primary branch of gonocoxite smoothly curved (fig. 45); posterior pair of phallic processes large, curved dorsad (fig. 48) ..... *H. baroua* sp. n.
8. Xth tergum basally erected dorsally (fig. 19); gonocoxite, with slender, sickle shaped primary branch (fig. 19); gonocoxite, with pair of additional medio-marginal processes (fig. 21) ..... 28
- Xth tergum basally not erected dorsally (fig. 97); gonocoxite with broad, rectanguloid primary branch (fig. 97); gonocoxite, without additional marginal processes (fig. 99) ..... *H. rembai* sp. n.
9. Xth tergum expanded dorsally (fig. 7) ..... 10
- Xth tergum not expanded dorsally (figs. 65, 83) ..... 21
10. IXth segment dorsal margin strongly concave and anterior apex rectanguloid ..... 11
- IXth segment dorsal margin substraight, or concave (if strongly concave the anterior apex is pointed or rounded) ..... 12
11. IXth segment with submarginal apodeme; IXth segment posteriorly produced into a rounded

- dorsal process; Xth tergum laterally about as broad as the gonocoxal primary branch; basomedian branch of gonocoxite slender in both ventral and lateral view ..... *H. lapidaria* Ross
- IXth segment without submarginal apodeme; IXth segment posteriorly not produced into a dorsal process; Xth tergum laterally about half as broad as the gonocoxal primary branch; basomedian branch of gonocoxite broad in ventral and lateral view ..... *H. starmuehlneri* Ross
12. Xth tergum with anterior lobe (fig. 7) ..... 13
- Xth tergum without anterior lobe (figs. 31, 51) ..... 19
13. Gonocoxal primary branch oriented in right angle to secondary branch (fig. 3) ..... 14
- Gonocoxal primary branch acute-angled to secondary branch (fig. 39) ..... 16
14. Hind wings fork 1 longer than its stalk; anal region with a brush of long, dark setae; distal half covered by long, curled setae; Xth tergum with three pairs of megasetae ..... *H. edmundsi* Ross
- Hind wings fork 1 shorter than its stalk (fig. 1); anal region without a brush of long setae (fig. 1); long curled setae absent (fig. 1); Xth tergum with six or more pairs megasetae (fig. 5) ..... 15
15. IXth sternum, lateral view, strongly produced anteriorly (fig. 3); IXth segment anterior apex nearly rectangular (fig. 3); Xth tergum with six pairs of megasetae (fig. 5); gonocoxite primary branch with sigmoid posterior margin (fig. 3) ..... *H. pellmyri* sp. n.
- IXth sternum, lateral view, slightly produced anteriorly; IXth segment with nearly rectanguloid anterior apex; Xth tergum with eight pairs of megasetae; gonocoxite primary branch with concave posterior margin ..... *H. hollowayi* Ross
16. Xth tergum with large anterior lobe (fig. 42); Xth tergum with less than eight pairs megasetae (fig. 40) ..... 17
- Xth tergum with small anterior lobe (fig. 30); Xth tergum with more than eight pairs megasetae (fig. 28) ..... 18
17. Gonocoxal primary branch about half as broad as Xth tergum; in ventral view gonocoxite without median process; basomedian branch of gonocoxite broad in lateral view ..... *H. caledonia* Ross
- Gonocoxal primary branch about as broad as Xth tergum (fig. 39); in ventral view, gonocoxite with small median process (fig. 43); basomedian branch of gonocoxite slender in lateral view (fig. 39) ..... *H. browni* sp. n.
18. VIth sternal process present; IXth segment strongly produced anteriorly from the submarginal apodeme; Xth tergal megasetae in dorso-basal and medio-lateral groups in addition to a single latero-apical seta; basomedian branches of gonocoxite curved laterad ..... *H. boullaria* Ross
- VIth sternal process absent; IXth segment slightly produced anteriorly from the submarginal apodeme (fig. 25); Xth tergal megasetae in large dorso-basal group in addition to a single latero-apical seta (figs 28, 30); basomedian branches of gonocoxite straight in ventral view (fig. 29) ..... *H. rossi* sp. n.
19. IXth sternum in lateral view not incised; Xth tergum, with dorsal rhomboid process; gonocoxite basal plate anteriorly pointed; basomedian branches of gonocoxite originate close to each other ..... *H. petersorum* Ross
- IXth sternum, lateral view, strongly incised (fig. 31); Xth tergum without dorsal process (fig. 31); gonocoxite basal plate rounded or truncate (figs. 34, 54); basomedian branches of gonocoxite originate distantly to each other ..... 20
20. IXth segment with about parallelogram shaped anterior part (fig. 31); IXth tergite without dorsal process (fig. 31); IXth tergite, dorsal view, with median margin concave (fig. 33); Xth tergum with long megasetae (figs. 33, 36); Xth tergum basoventral margin concave (fig. 36); gonocoxite, ventral view, with basomedian margin produced into a large, pointed process (fig. 34); basomedian branches strongly diverging (fig. 34) ..... *H. neocaledonia* sp. n.
- IXth segment with about trianguloid anterior part (fig. 51); IXth tergite with rounded dorsal process (fig. 51); IXth tergite, dorsal view, with broad process on median margin (fig. 55); Xth tergum with short megasetae (fig. 52); Xth tergum with basoventral margin produced into a triangular (fig. 52); gonocoxite, ventral view, with basomedian margin produced into a small, rounded process (fig. 54); basomedian branches with distal part slightly diverging (fig. 54) ..... *H. ouaroua* sp. n.
21. Xth tergum with four median pairs long, dark brown/blackish megasetae (figs. 83, 84) ..... 22
- Xth tergum without median megasetae, or if present, they are short, pale and oriented laterad (fig. 89) ..... 23
22. IXth tergite with a rounded dorsal process (fig. 83); Xth tergal megasetae about 1.5× longer than the secondary branch of gonocoxite; Xth tergum about as long as gonocoxite ..... *H. nigrospinosa* sp. n.
- IXth tergite without dorsal process (fig. 65); Xth tergal megasetae about as long as the secondary branch of gonocoxite; Xth tergum shorter than gonocoxite ..... *H. penicilla* sp. n.
23. Xth tergum with dorsobasal megasetae (fig. 89) ..... 24
- Xth tergum without dorsobasal megasetae (figs.

- 75, 78) ..... 25
24. IXth sternum anteriorly produced and pointed (fig. 89); Xth tergum with apical megasetae (fig. 89); Xth tergum with mediolateral short setae (fig. 89); gonocoxal primary branch spoon-shaped (fig. 89) ..... *H. livida* sp. n.
- IXth sternum anteriorly little produced, rounded; Xth tergum without apical megasetae; Xth tergum without mediolateral setae; gonocoxal primary branch shoe-shaped ..... *H. asymmetrica* Ross
25. Xth tergum with row of lateral megasetae confined to median part of the segment (fig. 78); gonocoxal primary branch apex more than 3 × wider than basal part (fig. 75) ..... *H. patriciae* sp. n.
- Xth tergum without megasetae on median part of the segment (fig. 110); gonocoxal primary branch apex about 2 × wider than basal part (fig. 109) ..... 26
26. Phallus with apical sclerous processes .... *H. vallo-*  
*nia* Ross
- Phallus without apical sclerous processes (fig. 113) ..... *H. gibbsi* sp. n.
27. Posterior wings with anal veins covered by small scaloid setae (fig. 12); fore leg without dorsal row of long blackish setae on tibia and tarsus; phallus without sclerous processes (fig. 16); gonocoxal primary and secondary branches diverging (fig. 15); basomedian branch of gonocoxite short (fig. 18) ..... *H. koghiensis* sp. n.
- Posterior wings without small scaloid setae on anal veins (fig. 67); fore leg with dorsal row of long, blackish setae distally on tibia and first tarsal segment (fig. 68); phallus with a pair of long sclerous processes (figs. 72, 73); gonocoxal primary and secondary branches about parallel (fig. 69); basomedian branch of gonocoxite long (fig. 71) ..... *H. tenuisa* sp. n.
28. Xth tergum with three pairs of additional processes (fig. 20); postero-lateral part of IXth segment not produced posteriad (fig. 19); gono-

coxite with a pair of additional processes (fig. 21) ..... *H. arma* sp. n.

– Xth tergum with one pair of additional processes; postero-lateral part of IXth segment produced and curved mediad; gonocoxite without additional processes ..... *H. koumaca* Ross

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THE FIRST RECORD OF THE GENUS  
*APOMETRIOCNEMUS* SÆTHER, 1985:  
*A. JAPONICUS* SP. N. FROM THE PALAEARCTIC  
REGION (DIPTERA: CHIRONOMIDAE)

Kobayashi, T. & Suzuki, H., 1999. The first record of the genus *Apometriocnemus* Sæther, 1985: *A. japonicus* sp. n. from the Palearctic Region (Diptera: Chironomidae). – Tijdschrift voor Entomologie 142: 65-67, figs. 1-9. [ISSN 0040-7496]. Published 22 September 1999.

*Apometriocnemus japonicus* sp. n. from Nagasaki, Western Japan is described. The new species is the first record from the Palearctic Region, and the second species of the genus. It differs from the first species *A. fontinalis* Sæther, 1985 from U.S.A. mainly in having an extremely small antennal ratio.

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Keywords. – Chironomidae; Palearctic; new species; *Apometriocnemus*

Sæther (1985) erected the new genus *Apometriocnemus* with the single included species *A. fontinalis* Sæther from Tennessee, U.S.A. Cranston & Oliver (1988) reported a second species of the genus, *A. beringensis* from Canada. This species was later transferred to the genus *Metriocnemus* by Sæther (1995). Thus, only one species of the genus has been described until now.

We collected by net sweeping in Nagasaki, Western Japan, specimens that based on Sæther's diagnosis belong to *Apometriocnemus*; thus *A. japonicus* sp. n. is the second described species in the genus and the first record for the Palearctic Region.

Seven male adults were examined. All specimens were preserved in 70 % ethanol prior to cleaning in 10% KOH and were mounted in Berlese fluid on microscope slides.

In the following description, measurements are usually expressed as the total range. The number of specimens examined was seven, except where otherwise noted; averages are given in parentheses. The general terminology follows that of Sæther (1980). All figures are based on the holotype except fig. 4, antenna.

*Apometriocnemus japonicus* sp. n.  
(figs. 1-9)

Type material. – Holotype: male imago (No. 293-3), Japan: Nagasaki Prefecture: Todorokikyo (32°K57' N, 130°K7' E), 7.xii.1991. – Paratypes: 6 male imagines (No. 293-21, 40, 42, 50, 68, 70), same data as holotype. All types are deposited in Sasa's collection (Aza Sunaba 135-3, Aramata, Kurobe-shi, Toyama Prefecture, 938-0001 Japan).

**Description**

Male imagines (n=7, except where otherwise stated). – Wing length 1.25-1.40 (1.33) mm. Wing length/ length of profemur 2.25-2.46 (2.34). Coloration pale brown with vittae and postnotum blackish brown.

Head (fig. 3). – Antenna with 13 flagellomeres (fig. 4, paratype). AR extremely low, i.e. 0.15-0.16 (0.16, n=4). Last flagellomere 66-78 (72.6, n=4) fÊm long. Temporal setae 15-27 (22.5); inner and outer verticals, and postorbitals indistinguishable from each other. Dorsomedial extension very weak. Clypeus 16-20 (17.3) setae, and 90-100 (97.1) µm wide and an-

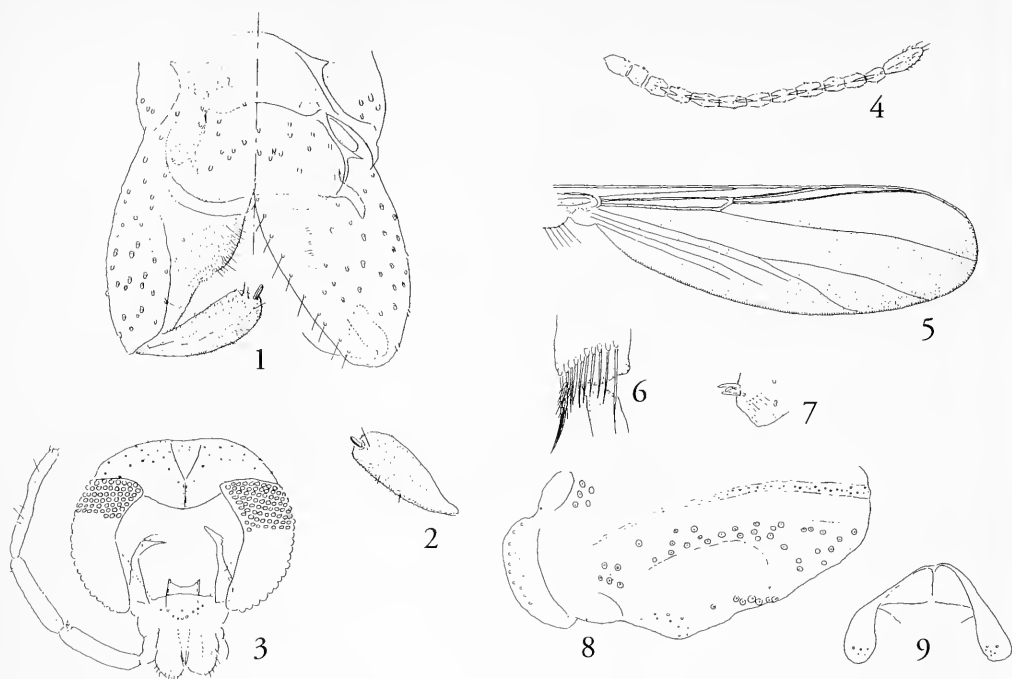


Fig. 1-9. *Apometriocnemus japonicus* sp. n., male imago. — 1, Hypopygium; 2, Gonostylus; 3, Head; 4, Antenna; 5, Wing; 6, Hind tibial comb; 7, Sensilla clavata on tip of palpomere III; 8, Thorax dorsal view; 9, Antepronotum.

tennal pedicel 90-100 (95.0)  $\mu\text{m}$  in diameter, clypeus 0.9-1.1 (1.02) times as wide as pedicel. Cibarial pump, tentorium and stipes as in fig.3. Tentorium 110-140 (126)  $\mu\text{m}$  long, 25-30 (25)  $\mu\text{m}$  wide at sieve pore. Palpomere length (in  $\mu\text{m}$ ,  $n=6$ ): 19-29 (25); 19-34 (29); 114-135 (128); 118-138 (130); 133-193 (165). Apex of third palpomere with 2-3 sensilla clavata (fig.7).

Thorax (fig.8). — Antepronotum with 3-8 (5.6,  $n=6$ ) setae lateral side (fig. 9). Dorsocentrals 22-36 (31.6,  $n=5$ ) from strong sockets. Acrostichals 25-34 (29.5,  $n=2$ ) also from distinct sockets. Prealars in anterior group of 6-8 (6.8,  $n=5$ ) and posterior group of 7-10 (8.6). Scutellum with 14-19 (16.5,  $n=6$ ): 9-10 stronger in posterior row, 6-7 weaker in front.

Wing (fig. 5). — Wing membrane with distinct punctation of microtrichia, relatively densely covered with setae. Anal lobe weak, not projecting.  $R_{2+3}$  runs close to  $R_1$  ending closer to end of  $R_1$  than to end of  $R_{4+5}$ . Vein  $R_{4+5}$  ends proximal to almost opposite to end of  $M_{3+4}$ .  $Cu_1$  slightly curved. VR 1.36-1.48 (1.40). Brachiolium with 7-8 setae, all veins except  $R_{2+3}$  with setae. Costa strongly extended, its extension 160-210

(194.3)  $\mu\text{m}$  long. Squama fringed with 4-6 (5.0,  $n=5$ ) setae.

Legs. — Spur of front tibia 28-32 (30.9)  $\mu\text{m}$  long, spurs of middle tibia 20-28 (23.2)  $\mu\text{m}$  and 15-20 (16.3)  $\mu\text{m}$  long, of hind tibia 42-55 (50.0)  $\mu\text{m}$  and 22-25 (23.6)  $\mu\text{m}$  long. Comb of hind tibia with 9-11 (9.8) setae 30-50  $\mu\text{m}$  long (fig. 6). Width at apex of front tibia 32-38 (34.9)  $\mu\text{m}$ , of middle tibia 33-42 (38.3)  $\mu\text{m}$ , of hind tibia 40-52 (47.5)  $\mu\text{m}$ . Pseudospur, sensilla chaetica and pulvilli absent. Length (in  $\mu\text{m}$ ) and proportions of legs are given in table 1.

Hypopygium (fig.1). — Anal point absent. Tergite IX with 12-14 (12.9) setae and weak hexagonal patterns laterally; laterosternite IX with 6-9 (6.5) setae. Phallapodeme 62-70 (69.0)  $\mu\text{m}$  long. Transverse sternapodeme 74-84 (80.9)  $\mu\text{m}$  long. Virga absent. Gonocoxite 145-158 (149.0)  $\mu\text{m}$ , with reduced inferior volsella. Gonostylus (fig. 2) 65-72 (69.6)  $\mu\text{m}$  long, megaseta 8-12 (10.0)  $\mu\text{m}$  long.

Female imago, larva and pupa are unknown.

## Diagnosis

Characters of the present specimens agree with the

Table 1. Length ( $\mu\text{m}$ ) and proportions of legs (means in parentheses).

	fe	ti	ta1	ta2	ta3	ta4	ta5	LR	BV	SV
p1	510-620 (572.3)	540-660 (618.6)	370-460 (425.0)	190-240 (214.5)	140-170 (152.2)	80-100 (90.6)	70-80 (76.1)	0.67-0.71 (0.67)	2.94-3.18 (3.02)	2.74-2.85 (2.79)
p2	550-675 (629.5)	540-650 (603.0)	270-340 (308.0)	125-150 (138.0)	100-125 (114.0)	70-80 (76.0)	60-75 (68.0)	0.49-0.52 (0.51)	3.87-3.97 (3.90)	3.88-4.18 (4.03)
p3	590-720 (658.2)	700-850 (780.0)	340-410 (375.5)	150-190 (173.9)	150-190 (168.0)	80-110 (102.0)	60-80 (74.0)	0.48-0.50 (0.48)	3.36-3.79 (3.51)	3.70-4.01 (3.84)

generic diagnosis of *Apometriocnemus* by Sæther (1985) in having hairy wings, squamal setae, curved  $\text{Cu}_1$ , long costal extension, acrostichals and dorsocentrals from clear sockets, lacking tarsal pseudospurs, sensilla chaetica, pulvilli and anal point proper; and in having a reduced inferior volsella. It is obvious that the specimens belong to the genus *Apometriocnemus*.

The male imago of *A. japonicus* sp. n., however, is clearly separable from *fontinalis* by its significantly lower antennal ratio, i.e. 0.15-0.16 in *japonicus*, 0.91 in *fontinalis*. Other characters that may further separate the new species from the known species are the longer apical palpomere than penultimate one (apical one 1.27 times as long as 4<sup>th</sup> palpomere in *japonicus*, but 0.82 times in *fontinalis*), and higher leg ratios of front and middle legs. The front leg ratio in *japonicus* is 0.67, but 0.54 in *fontinalis*; the middle leg ratio 0.51 in the former, 0.43 in the latter. *A. japonicus* has more numerous dorsocentrals, namely 16 in *fontinalis*, and 22-36 in *japonicus*. The number of acrostichals of *japonicus* (25-34) is much more than that of *fontinalis* (10). The dorsomedial extension is wedged shaped in *fontinalis* but very weakly so in *japonicus*. Venarum ratio of *japonicus* is a little larger (1.40) than that of *fontinalis* (1.22). The structure of the gonostylus and gonocoxite of these two species shows many similarities, including the absence or vestige of an inferior volsella and anal point.

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## BOOK REVIEWS

M. Hansen, 1997. Phylogeny and classification of the staphyliniform beetle families (Coleoptera).— *Biologiske Skrifter Kongelige Danske Videnskabernes Selskab* 48: 1-339, figs 1-492. Paperback. [ISSN 0366-3612, ISBN 87-7304-286-2. Price DKK 600]. Available from Apollo Books, Stenstrup, Denmark.

Although a few faunistically working coleopterists may still be unaware of the massive changes that have affected the family-group classification of the Coleoptera for more than a decade, most of the professionals and amateurs working on and with beetles must have sensed something, if only for the appearance of continually changing family-group positions of their favourite subjects in more or less critical checklists. The author of the above publication has a few years ago (1996), with some of his colleagues, published a checklist of the Coleoptera of Denmark, implementing many of the recent views on the evolution, classification and nomenclature of coleopteran families and their components. Michael Hansen is one of the numerous movers in the wholesale revision of the classification of Coleoptera, and this is not the first of his products in the field – see, for instance, Hansen's publication on the Hydrophiloidea in the same series, reviewed by Huijbregts, in volume 135 (1992: 42) of this journal.

This 1997 publication by Hansen consists of a detailed phylogenetic analysis of 119 characters of representatives of staphyliniform beetle families (Hydrophiloidea, Histeroidea, Staphylinioidea) and a few others (the so-called outgroups), followed by discussions and conclusions with regard to their classification. Computer programmes applied include PAUP, Hennig, and MacClade – all familiar to students of cladistics. The analytical parts are followed by a systematic part treating the various families recognised, including descriptions and keys down to subfamily

level. The text is supported by cladograms, a tabular character matrix, annotated lists of characters, habitus pictures, and illustrations of the characters used in the analysis. The results are well documented and amply compared with those of other workers – the bibliography is a useful gateway to the literature for those not familiar with recent family-group level systematics of the Coleoptera. The format of the publication follows the well-known standard for this series of the Royal Danish Academy of Sciences and Letters, and the printing again shows the usual quality.

This volume is a must for the student of the general classification and evolution of Coleoptera, irrespective of the question whether one agrees with the conclusions of the author. Hansen himself recognises, judged from observations throughout his text, quite well that the position he takes with respect to various critical issues has to remain tentative. The complex questions of character parallelism, convergence, homoplasy, or whatever they may be called in modern cladistics, continue to loom heavily. But if, considering the amount of work that has gone into this study, Hansen and his colleagues cannot ultimately solve them, who can? New techniques are becoming available, and, undoubtedly, in the near future, the analysis of molecular characters will shed more light on coleopteran family-group relationships. Meanwhile, simple coleopterists like myself, will have to live with situations like a family position for the Scaphidiidae as maintained here by Hansen, and at the same time a subfamily position as maintained by leading specialists in this group (Loebl 1997, for instance in a world catalogue of the Scaphidiinae). The beetles themselves, as we study them, won't change – and I'm sure they won't mind which rank in the systematic hierarchy they are being attributed by us humans.

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# WOOD GNATS OF THE GENUS *SYLVICOLA* (DIPTERA, ANISOPODIDAE): TAXONOMIC STATUS, FAMILY ASSIGNMENT, AND REVIEW OF NOMINAL SPECIES DESCRIBED BY J. C. FABRICIUS

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Comments are given on the contents and relationships of *Sylvicola* Harris, 1780, an important genus of anisopodid gnats. *Tonnoirina* Amorim & Tozoni, 1994 is sunk as a new junior synonym. At the family-group level aspects of nomenclature, fossils and taxon/lineage definitions are dealt with, and the phylogenetic structure of extant wood gnats discussed. It is preferred to treat them all in a single family and to abandon other formal supra-generic classification. A composite maxillo-labial 'mentum' is a remarkable state of the adult mouthparts that seems to combine the *Mycetobia*- and *Olbiogaster*-groups. Finally, the identity of three nominal species of *Sylvicola* has been checked and lectotypes designated on basis of authentic type material. All three are from Europe and were described by J. C. Fabricius. *Sylvicola subfuscatus* Krivosheina & Menzel, 1998 is a new junior synonym of *S. fuscatus* (Fabricius, 1775) and *S. fuscatooides* sp. n. is proposed for '*S. fuscatus* Fabricius' of recent authors.

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Wood gnats or Anisopodidae in the sense of Hennig (1973) and Peterson (1981), i.e. including *Sylvicola* Harris, *Olbiogaster* Osten Sacken, *Mycetobia* Meigen and related genera, are today a small family of nematocerous Neodiptera (see Michelsen 1996a) with ca. 120 species described. However, a rich fossil record suggests that the direct lineage leading to the modern family can be traced back to early Middle Mesozoic (200+ Myr). The family is rather cosmopolitan, occurring in arboreal habitats ranging from tropical to cold-temperate climates. A few species of *Sylvicola*, the so-called 'window gnats', are very common in domestic situations. Anisopodid larvae are terrestrial saprophages living in decaying organic matter. Rotting wood and sap runs seem favourable to many species of anisopodids, but a much wider range of breeding media, including manure and decaying vegetables, are utilised by the common window gnats.

The purpose of this paper is to discuss and clarify various topics that relate to the systematics of *Sylvicola*. The nomenclature and synonymy of the genus is considered first, followed by some supra-generic issues (family nomenclature, status of fossil names, relationships and classification of extant genera). Finally,

the identity of nominal species of *Sylvicola* described by J. C. Fabricius (and other 18th century authors) is assessed.

Acronyms for depositories: ZIUL, Zoological Institute, University of Lund; ZMUC, Zoological Museum, University of Copenhagen.

## TAXONOMIC STATUS OF *SYLVICOLA* HARRIS

Over time there has been consensus on gathering most species of wood gnats into a single genus based on characters of the wing: vein  $R_{2+3}$  strongly sinuous and wing membrane with macrotrichia. By that diagnosis the genus is large (about 75 extant species known) and distributed worldwide. Yet, the simple question of what name to apply for it has been a most contentious issue. Meigen (1818) ignored his own earlier (Meigen 1803, 1804) proposal of the name *Anisopus*, and all subsequent 19th century authors adopted the name *Rhyphus* Latreille, 1804. Upon the discovery of an obscure pamphlet issued by Meigen (1800), Hendel (1908, 1928) introduced the senior name *Phryne*, a course followed notably by German and French authors. However, a still older name was introduced through Coquillett's (1910) fixation of a

type-species for *Sylvicola*. Harris (1780: 100, pl. 31) proposed that generic name for nine newly described British species of the present families Rhagionidae (7), Athericidae (1) and Anisopodidae (1). It was first given as '*Sylvicolae*', but appears in proper singular form in the legend to plate 31 (on p. [4] of the 'Index'). Knab (1912) was not convinced about the validity of either of the names *Sylvicola* and *Phryne*. Instead, he adopted the name *Anisopus* on grounds that it has priority over *Rhyphus*, a course followed notably by British and American authors. Eventually, the senior name *Sylvicola* gained general acceptance by the early 1960s, probably on the influence of Melville's (1960) report leading to the suppression of all Meigen-1800 names in 1963. That report (pp. 31-32) clarified the nomenclatorial status of the oldest genus-group names in Anisopodidae.

Based on the small Nearctic fauna (five species only), a division of *Sylvicola* into two subgenera, *Sylvicola* s. str. and *Anisopus* was attempted by Pratt & Pratt (1980). However, as argued by Amorim & Tozoni (1994), such action probably leaves *Sylvicola* s.str. paraphyletic in terms of *Anisopus*. These authors proposed instead a division of the former genus *Sylvicola* into a Laurasian and a Gondwanan component. *Sylvicola* was maintained for the Laurasian group of about 15 species, and a new genus, *Tonnoirina* was erected to accommodate the Gondwanan group (60 Oriental, Australian, Afrotropical and Neotropical species). However, I find that classification equally difficult to accept. The only evidence given in support of the monophyly of *Tonnoirina* is the dorsally contiguous state of the male eyes. Considering the frequent occurrence of extreme male holopticism in the basal groups of Neodiptera, this is not much of an argument. Even among wood gnats, the contiguous state of the male eyes is not confined to *Tonnoirina*. It occurs at least in *Sylvicola punctatus* (Fabricius) and in all *Mesochria* Enderlein. Finally, an examination of material from Terra del Fuego, Argentina (in ZMUC) revealed that the 'Gondwanan' *Anisopus andinus* Edwards, 1930 is not a species of *Tonnoirina* but a *Sylvicola* in the sense of Amorim & Tozoni: male eyes narrowly separated dorsally; female with a single spermatheca. Edwards (1930: 115) was evidently right in suggesting that a close relationship exists between the 'Gondwanan' *andinus* and the 'Laurasian' *fenestralis*-species group.

On the above evidence, I prefer to maintain *Sylvicola* in the accustomed broad sense. The formal synonymy is as follows:

## Genus *Sylvicola* Harris, 1780

- Sylvicola* Harris, 1780: 100, index [4]. Type-species *Sylvicola brevis* Harris, 1780 [= *Tipula fenestralis* Scopoli, 1763], by designation of Coquillett (1910: 610).  
 [Phryne Meigen, 1800: 16. Unavailable, suppressed by I.C.Z.N. (1963: 339).]  
*Anisopus* Meigen, 1803: 264. Type-species *Anisopus fuscus* Meigen, 1804 [= *Tipula fuscata* Fabricius, 1775], by designation of Coquillett (1910: 507).  
*Rhyphus* Latreille, 1804: 188. Type-species *Tipula fenestralis* Scopoli, 1763 [as '*fenestrarum*'], by monotypy. *Tonnoirina* Amorim & Tozoni, 1994: 531. Type-species *Anisopus festivus* Edwards, 1928, by original designation. **Syn. n.**

## FAMILY ASSIGNMENT OF SYLVICOLA HARRIS: A COMMENTARY ON THE SUPRA-GENERIC CLASSIFICATION OF WOOD GNATS

### Nomenclature

The following list presents, in chronological order, all the family-group names that have been proposed for extant and fossil (†) groups of anisopodid or alleged 'anisopodiform' gnats. Evenhuis (1994) should be consulted for full references to the literature on the fossil names.

- Rhyphidae Newman, 1834: 379, 387 [as Rhyphites]. Type-genus *Rhyphus* Latreille, 1804.  
 Mycetobiinae Winnertz, 1863: 657 [as Mycetobiinae]. Type-genus *Mycetobia* Meigen, 1818.  
 †Protorhyphidae Handlirsch, 1906, Fossilen Insekten: 487. Type-genus *Protorhyphus* Handlirsch, 1906 (Lower Jurassic).  
 Anisopodidae Knab, 1912: 111 [as Anisopidae]. Type-genus *Anisopus* Meigen, 1803. Replacement name for Rhyphidae.  
 [Phrynidae Hendel, 1928: 9, 63 [as Phryneidae]. Type-genus *Phryne* Meigen, 1800. Unavailable replacement name for Rhyphidae, type-genus suppressed for the purposes of zoological nomenclature].  
 Olbiogastridae Hennig, 1948: 78 [as Olbiogasteridae]. Type-genus *Olbiogaster* Osten-Sacken, 1886.  
 †Oligophrynidae Rohdendorf, 1962, [Fundament. Paleont.] 9: 332 [as Oligophryneidae]. Type-genus *Oligophryne* Rohdendorf, 1962 (Lower Jurassic).  
 †Protolbiogastridae Rohdendorf, 1962, [Fundament. Paleont.] 9: 332. Type-genus *Protolbiogaster* Rohdendorf, 1962 (Lower Jurassic).  
 [Sylvicolidae Hennig, 1954: 290. Type-genus *Sylvicola* Harris, 1780. Unavailable, published as a synonym of Phryneidae].  
 Sylvicolidae Alexander, 1962: 3, 7. Type-genus *Sylvicola* Harris, 1780. Replacement name for Anisopodidae.  
 †Crosaphididae Evans, 1971, Mem. Queensl. Mus. 16: 146. Type-genus *Crosaphis* Evans, 1971 (Upper Triassic).  
 †Limnorhyphidae Hong, 1983, [Middle Jurass. Ins. N. China]: 132. Type-genus *Limnorhyphus* Hong, 1983 (Middle Jurassic).  
 †Siberhyphidae Kovalev in Kalugina & Kovalev, 1985, [Dipt. Ins. Jurass. Sib.]: 123. Type-genus *Siberhyphus* Kovalev in Kalugina & Kovalev, 1985 (Middle Jurassic).

Lobogastrini Amorim & Tozoni, 1994: 530. Type-genus *Lobogaster* Philippi, 1865.  
 Eogastrini Amorim & Tozoni, 1994: 530. Type-genus *Eogaster* Amorim & Tozoni, 1994.  
 Valseguyinae Amorim & Tozoni, 1994: 533. Type-genus *Valseguyia* Colless, 1990.  
 Mesochriini Amorim & Tozoni, 1994: 533. Type-genus *Mesochria* Enderlein, 1910.

The priority principle of the Zoological Code does not in itself suggest that the valid family-group name for wood gnats is indeed Anisopodidae. This follows from another provision of the Code (Article 40, Section b): Knab (1912) replaced the name Rhyphidae Newman, 1834 by Anisopodidae on the ground that *Rhyphus* Latreille, 1804 is a junior subjective synonym of *Anisopus* Meigen, 1803. As the name Anisopodidae was introduced before 1961 and has won general acceptance, it takes precedence of the replaced name and is to be maintained with its own author. According to Recommendation 40A of the Code the name is correctly cited as 'Anisopodidae Knab, 1912 (1834)'.

Alexander (1962) attempted to replace Anisopodidae by Sylvicolidae on the ground that *Anisopus* Meigen, 1803 is a junior subjective synonym of *Sylvicola* Harris, 1780. By taking place after 1960, this action was not valid (see the Code, Article 40, Section a). Even if an earlier, pre-1961 use of Sylvicolidae might be found in the literature, this would not make Sylvicolidae a valid family-group name, as it has never won general acceptance.

### Fossil wood gnats: the lineage Anisopodidae

There are two reasons for the high number of supra-generic names proposed in the small family of wood gnats. First, a rich and varied record of 'anisopodiform' fossils (mostly wing impressions) from Mesozoic sediments has given rise to several family-group names. Second, a very elaborate supra-generic classification that formally ranks extant wood gnats as a superfamily (Anisopodoidea) consisting of no less than three families, four subfamilies and four tribes (see below) has been proposed by Amorim & Tozoni (1994).

Precise ideas on the relationships of Mesozoic 'anisopodiform' fossils may never be obtained considering the limited number of available characters that almost exclusively refer to aspects of the wing. Therefore, all fossil family-group names of the above list may by necessity be referred *incertae sedis* to the lineage Anisopodidae. Following Michelsen (1996b), such lineage is defined as the stem-based or 'most inclusive' clade that contains only wood gnats among its recent species. The true family or taxon Anisopodidae, according to Michelsen (1996b), is defined as the node-based or 'least inclusive' clade that contains

all recent species of wood gnats. Evenhuis (1994: 559) gives Lower Jurassic as minimum age for the family Anisopodidae. However, that information is of little use in the absence of criteria for what makes a fossil qualify as an anisopodid. It appears to me that 'Anisopodidae' in the sense of Evenhuis is more inclusive than the taxon but less inclusive than the lineage by that name. This concern is surely relevant, considering that the age difference between the lineage and the taxon Anisopodidae could possibly amount to a hundred million years.

### Extant wood gnats: the taxon Anisopodidae

It is widely acknowledged that extant wood gnats are monophyletic and can be partitioned into three primary subgroups as follows: (1) a widespread group of *Sylvicola* only, (2) a pantropical group of *Olbiogaster* and some smaller genera, and (3) a widespread group of *Mycetobia* and some smaller genera. Strong synapomorphies for the Anisopodidae are the deep sensory vesicle of palpomere III of the maxilla and the missing male tergite IX (= epandrium). Among the subgroups only the *Sylvicola*-group and the *Mycetobia*-group are obviously monophyletic: the first on account of a long, basally coiled aedeagus, the second due to the fusion of palpomeres I-III of the maxilla and the missing cell d and vein M<sub>3</sub> of the wing. The *Mycetobia*-group was initially nested within Mycetophilidae (s.lat.) based on resemblance in the wing venation, but Edwards (1916) and Keilin (1919) remedied that mistake on strong morphological evidence from both adults and immatures.

Amorim & Tozoni (1994) considered the *Olbiogaster*-group as standing outside the *Sylvicola* + *Mycetobia*-groups. The presence of maximally two spermathecae in the *Sylvicola* + *Mycetobia*-groups (three in the *Olbiogaster*-group) speaks in favour of this scheme, while additional evidence given by the authors appears subtle or poorly documented. A different scheme, in which the *Sylvicola*-group stands outside the *Olbiogaster* + *Mycetobia*-groups, is favoured here on basis of characters of the adult mouthparts. A remarkable, perhaps plesiomorphic state in wood gnats is the presence of a setose postlabial plate apparently representing the mentum. This structure in *Sylvicola* and *Mycetobia* is finely illustrated by Peterson (1916: pl. V, figs. 80 and 90). In *Sylvicola* the mentum is moderate-sized and unmusculated, lying in a membrane between the maxillary cardines and stipites. In *Mycetobia* the mentum is enlarged and anterolaterally merged with the maxillary cardines + stipites. Evidence for such fusion comes from my observation that the anterolateral angles of this 'mentum' receive two sets of maxillary muscle, the tentorial adductors of cardo and stipes respectively. The 'mentum' in *Mycetobia* further gives rise to a set of

maxillary muscle, the stipital abductor of palpomeres I-III (in *Mycetobia* – unlike *Sylvicola* and *Olbiogaster* – the three basal-most maxillary palpomeres are joined into a single segment). I have not been able to study specimens of the *Olbiogaster*-group, but it is obvious from Edwards' (1916) comparative study that the exceptional fusion of labial and maxillary parts is also characteristic of that group. Additional evidence for the monophyly of the *Olbiogaster* + *Mycetobia*-groups is provided by the straight vein  $R_{2+3}$  that distally strongly approaches  $R_1$ . However, ample support for the monophyly of the *Olbiogaster*-group is still wanting.

Cladistic ambiguity, especially with respect to the *Olbiogaster*-group, makes me prefer to recognise but a single family of extant wood gnats. This contrasts with the opinion of Russian dipterists (see Krivosheina 1997a, 1997b) and Amorim & Tozoni (1994) that the *Mycetobia*-group, or the *Mycetobia*- and *Olbiogaster*-groups, should be ranked as families. Under the circumstances I also see no point in adopting any formalised supra-generic classification.

#### THE NOMINAL SPECIES OF SYLVICOLA DESCRIBED BY J. C. FABRICIUS

Wood gnats of the genus *Sylvicola* Harris include several species that are common throughout most parts of North and Middle Europe. The modern era of taxonomic treatment of the genus started with Edwards (1923), who identified five European species (in *Anisopus*) on the basis of diagnostic characters of the male terminalia: *fenestralis* Scopoli, *cinctus* Fabricius, *zetterstedti* Edwards, *limpidus* Edwards and *punctatus* Fabricius. In a subsequent treatment of the world fauna of Anisopodidae, Edwards (1928) added a sixth species, *fuscatus* Fabricius, from continental Europe. Lindner (1930) recognised the same species (in *Phryne*) in a revision of the Palaearctic species, while Freeman (1950) gave an illustrated key to the four British species (in *Anisopus*). In a review of the Nearctic species of *Sylvicola*, Stone (1965) concluded that three out of five species (*S. punctatus*, *S. fuscatus* and *S. fenestralis*) are Holarctic and were first described from Europe. Pratt & Pratt (1980) gave a taxonomic up-date of the same species. Pedersen (1968), in a review of Danish *Sylvicola*, added differences in the female terminalia as a means of species separation. Hancock (1989) and Söli (1992) reviewed the taxonomy and faunistics of the Scottish and Norwegian species. Haenni (1997), in a paper on Swiss *Sylvicola*, described a new species (*S. baechlii*) from Switzerland and France. Finally, in a Palaearctic revision of *Sylvicola*, Krivosheina & Menzel (1998) added two new species to the European list (*S. stackelbergi*, *S. subfuscatus*) but missed, for obvious reasons, the species de-

scribed by Haenni (1997). Thus, a total of nine species of *Sylvicola* are presently recorded from Europe.

Despite the impressive amount of recent systematic work on European wood gnats, a newly introduced misconception needs to be remedied. It concerns the misidentification of *Tipula fuscata* Fabricius, 1775, a name always considered valid in the Anisopodidae. The opportunity is taken also to report on two other nominal species of wood gnats described by Fabricius and both currently assigned to *Sylvicola*.

#### The identity of *Tipula fuscata* Fabricius

##### *Sylvicola fuscatus* (Fabricius, 1775)

[*Musca nigricans*; *alis antice albo nigroque variis* Linnaeus, 1746: 314, 1761: 553. Unavailable, non-binominal.]  
*Tipula fuscata* Fabricius, 1775: 755, 1781: 410; Zimsen 1964: 453.

*Rhagio fuscatus* (Fabricius): Fabricius 1787: 332, 1794: 273.  
*Musca nigricans* Villers, 1789: 509. Synonymized by Thompson & Pont 1993: 100.

*Musca fuscata* (Fabricius): Gmelin 1790: 2865.

*Anisopus fuscus* Meigen, 1804: 103, pl. 6 (4). Synonymized by Meigen 1818: 322.

*Sciara fuscata* (Fabricius): Fabricius 1805: 58.

*Rhyphus fuscatus* (Fabricius): Meigen 1818: 321, pl. 11(18); Meigen in Morge 1975: 395, 486, pl. 25 (1a-g).

*Anisopus fuscatus* (Fabricius): Edwards 1928: 13, 17.

*Phryne fuscata* (Fabricius): Lindner 1930: 6.

*Sylvicola fuscatus* (Fabricius): Michelsen 1996a: 85, figs. 13, 14; Haenni 1997: 183; Kassebeer 1999: 16.

*Sylvicola (Anisopus) subfuscatus* Krivosheina & Menzel, 1998: 206, 215, figs. 3, 12-15. **Syn. n.**

*Sylvicola subfuscatus* Krivosheina & Menzel: Haenni 1998: 148.

Note. – In the second edition of 'Fauna Svecica', Linnaeus (1761: 545-556) gave a list of insect and other invertebrate species cited verbatim from his non-binominal first edition of 'Fauna Svecica' (Linnaeus 1746). The list contains species that he could no longer identify and thus intentionally excluded from further systematic treatment (see Thompson & Pont 1993: 12-13). Fabricius (1775: 755), when describing *Tipula fuscata*, evidently attempted to resurrect one of the Linnaean species of that list ('2310. MUSCA nigricans; alis antice albo nigroque variis', p. 553), but for unknown reasons he emended the original diagnosis in his reference to Linnaeus: 'Musca fuscata nigricans... Linn. Fn. Sv. 2310.' The name *Musca nigricans* appears subsequently as a proper binomen in the third edition of 'Fauna Svecica' by Villers (1789: 509).

Type material. – Lectotype, ♂, by present designation, 'Suecia' [= Sweden], in Coll. Fabricius [= 'Kiel' of Zimsen 1964: 453] (ZMUC). The lectotype, on a

short pin with a Fabrician label reading 'fuscata', is in bad shape due to an old dermestid attack: only parts of the thorax, most of the wings, basal half of the abdomen, left mid tibia and most of left hind leg remain. The alleged origin from Sweden and the reference to Linnaeus suggest that the lectotype could be an authentic Linnaean specimen that Fabricius obtained during his visit to Uppsala in 1762.

**Identity.** – The remains of the lectotype belong to a species of *Sylvicola*. The slender proportions of the abdomen and the inflated 1st tarsomere of hind leg show that it is a male. The thick 1st tarsomere of the hind leg, absence of dark markings behind and distal to vein  $R_{2+3}$ , common origin of  $M_1$  and  $M_2$  from the discal cell, and large size (wing 8.2 mm, hind tibia 4.2 mm) leave no doubt that this species was correctly identified by Meigen (1818) and most subsequent European authors.

Unfortunately, when Krivosheina & Menzel (1998) realised that two additional species with a *fuscatus*-like wing pattern occur in the northern outskirts of Europe, they followed Andersson (1967) in misapplying the name *fuscatus* for a species recorded only once from northern Sweden and elsewhere found only in the Far East of Russia. The well-known Central and East European species – for which the Fabrician name *fuscatus* had been correctly applied since Meigen (1818) – was described as a new species, *S. subfuscatus*, by Krivosheina & Menzel (1998). A hasty action indeed, considering the existence of another available name, *Anisopus fuscus* Meigen, 1804 (type locality: Germany, Stolberg).

It is strange though that the occurrence of true *S. fuscatus* (Fabricius) in Sweden, as evidenced by the identity of the lectotype, has not subsequently been confirmed. Also, Pedersen (1968) did not know the species from Denmark. Both circumstances might suggest that Fabricius (1775) gave the type locality 'Suecia' by mistake. However, I am able to confirm that the distribution of *S. fuscatus* – at least today – covers the southernmost parts of Scandinavia. First, on searching through the collections of Swedish Anisopodidae in the ZIUL, I found 1 ♂ of this species collected 3.vii.1995 in Lund (Scania) by H. Andersson. Second, based on own observations I consider that *S. fuscatus* in recent years has become a fairly common insect in gardens and parks in the Copenhagen area (NE Zealand), where from I first discovered it in April 1990.

**Distribution.** – Europe, ranging from France and Italy to southern Scandinavia, eastward to Russian Transcaucasus.

A record from Finland (Hackman 1980) almost certainly refer to either *S. stackelbergi* Krivosheina &

Menzel or *S. fuscatooides* sp. n. (see below). North American records (Stone 1965, Pratt & Pratt 1980) might either refer to *S. stackelbergi* or some undescribed, endemic species.

### *Sylvicola fuscatooides* sp. n.

[*Sylvicola (Anisopus) fuscatus* (Fabricius): Andersson 1967: 121, fig. 1; Krivosheina & Menzel 1998: 202, 215, figs. 1, 5-6. Misidentifications.]

**Type material.** – Holotype ♂, Sweden: Jämtland, Undersåker, Vallbo, 13.vii.1935, O. Ringdahl (ZIUL). Paratype ♂ (abdomen missing), Sweden: Lycksele Lappmark, Tärnasjön, Strutejokk near Skidbäcksbarracken, 14.vii.1963, leg. Andersson, Enckell & Hyllén-Cavallius (ZIUL).

**Description.** – For a detailed description of the present species, I refer to '*Sylvicola fuscatus*' of Krivosheina & Menzel (1998). The absence of dark wing markings behind and distal to vein  $R_{2+3}$  combined with the simple, acutely pointed male hypoproct will serve to identify males the present species. Females cannot presently be reliably separated from the very similar *S. fuscatus* (Fabricius) and *S. stackelbergi* Krivosheina & Menzel.

**Distribution.** – Sweden: Jämtland; Lycksele Lappmark (Andersson 1997). Russia (Far East): Primorskiy Kray (Krivosheina & Menzel 1998).

### The identity of *Rhagio punctatus* Fabricius

#### *Sylvicola punctatus* (Fabricius, 1787)

*Rhagio punctatus* Fabricius, 1787: 333, 1794: 274; Zimsen 1964: 453.

*Sciara punctata* (Fabricius): Fabricius 1805: 59.

**Type material.** – Lectotype, ♀, by present designation, 'Kiliae' [= Kiel, Germany], 'Daldorf' [= D. K. Daldorff], in Coll. Fabricius [= 'Kiel' of Zimsen 1964: 453] (ZMUC). Only the left wing remains, mounted upside down on a piece of cardboard on a short pin with a Fabrician label reading 'punctatus'.

**Identity.** – The lectotype belongs to a species of *Sylvicola*. The length:width ratio of the existing wing (<2.9) indicates that it belongs to a female. The characteristic dark pattern of the wing also confirms that Meigen (1818) and subsequent authors have identified this species correctly.

## The identity of *Rhagio cinctus* Fabricius

### *Sylvicola cinctus* (Fabricius, 1787)

*Rhagio cinctus* Fabricius, 1787: 333, 1794: 275; Zimsen 1964: 453.

*Sciara cincta* (Fabricius): Fabricius 1805: 60.

Type material. — Lectotype, ♂, by present designation, 'Kiliae' [= Kiel, Germany], 'Daldorf' [= D. K. Daldorff], in Coll. Fabricius [= 'Kiel' of Zimsen 1964: 453] (ZMUC). Only the wings and some leg fragments remain of the lectotype, attached to a short pin with a Fabrician label reading 'cinctus'.

Identity. — The lectotype belongs to a species of *Sylvicola*. The length:width ratio ( $> 3.0$ ) indicates that the wings are of a male. The wing pattern fits either of two common and widespread European species presently known as *Sylvicola fenestralis* (Scopoli, 1763) and *S. cinctus* (Fabricius, 1787). These species are very similar and cannot be reliably separated on external facies. Accordingly, *cinctus* was considered a junior synonym of *fenestralis* during the first half of the nineteenth century. Zetterstedt (1850: 3437) reinstated *cinctus* as a valid species and distinguished it from *fenestralis* on smaller size and lighter colouring. Subsequent authors accepted this course. Actual proof of the existence of two species came first with Edwards (1923) who found stable differences in the male terminalia (females remained inseparable until the work of Pedersen 1968). Edwards also noted that light-coloured specimens were generally males of one species while dark-coloured males might belong to either of the two. His use of the name *cinctus* for the overall smaller and more lightly coloured species gains support from what is left of the lectotype combined with a sentence of the original description: 'Thorax testaceus, immaculatus.' (Fabricius 1787: 333).

The current identity of *fenestralis*, as established by Edwards (1923) will remain a matter of convention. Scopoli (1763: 322) described *Tipula fenestralis* from 'Carniolica' [= Carniola, = Crain], an ancient duchy that equals the present Slovenia. All that can be deduced from the name and description is that of a species of *Sylvicola*. The same goes for another old name, *Sylvicola brevis*, described and illustrated by Harris (1780: 104, pl. 31). It has, since Kertész (1902: 304), been treated conveniently as a junior synonym of *fenestralis*.

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## BOOK REVIEW

Pjotr Oosterbroek, 1998. The families of Diptera of the Malay Archipelago. – Fauna Malesiana Handbooks, 1: i-xii, 1-227, 214 figs. E.J. Brill, Leiden, etc. Hardback. [ISBN 90-04-11053-4; ISSN 1388-3895]. Price NLG 190.– (US \$ 112.–); subscribers to series NLG 162.– (US \$ 95.50)

The series of manuals and handbooks on the dipterous fauna of larger regions has been enriched with a volume on the families of Diptera of the Malay Archipelago. It is published in the new series Fauna Malesiana Handbooks, a series 'intended to transfer hitherto dispersed information on the biodiversity of the animal resources in Southeast Asia to users in the region and beyond.' Since it is also to be used by non-specialist workers in the region, the scope is far less presumptuous than, e.g., the Manual of Nearctic Diptera and the Contributions to a Manual of Palaearctic Diptera. Nevertheless, it covers basically the same aspects of dipterology as these multi-volume works, though sometimes only briefly.

Three introductory chapters deal with the scope of the book and a short history of Southeast Asian dipterology, the classification and the life stages. Each chapter has its own short introduction and then briefly discusses the subject at hand, sometimes cutting it almost to the bare essentials. However, since each family is discussed later on in the book, many facts not dealt with in these chapters are done justice later. The adult morphology is discussed adequately in the fourth chapter and a list of morphological terms will point one to the description of the body part involved.

The remaining chapters contain the keys, family descriptions, illustrations and references. The first key will point one first to the major groups of Diptera and subsequent keys will lead to the families. As in all works covering the whole order Diptera, a separate key is given for identification of species with absent or reduced wings. The keys are to the point and prepared with care. No effort was made to force characters to comply with the wish that families should be keyed out only once. Whenever it was more practical to key out a family more than once this was done, e.g., the Perisclididae appear four times in the key to Acalyptrate families. This feature enhances the usefulness of the key considerably.

The discussions of the families are rather diverse. Several other specialists than Oosterbroek contributed

here (A. Borkent, P.S. Cranston, D.A. Duckhouse, N.L. Evenhuis, P. Grootaert, J.W. Ismay, D.K. McAlpine, T. Pape, A.C. Pont, M. Sasakawa, M. von Tschirnhaus, P. Villkamaa). Partly, however, the diversity is inevitable since the knowledge about different aspects of each family is very diverse. In general for most families there is a short description of morphology and biology, a short discussion of world status and regional fauna, and a short list of references (with notes on the aspects they cover). Especially the families containing harmful species (either agricultural or medical) receive more attention. In these cases the harmful aspects, e.g., transmitted diseases, damage to crops, etc., are briefly discussed. An extra is the inclusion of families that could occur in the area covered but not yet recorded. This broadens the possible use of the book in that respect that it can be used in a larger area than that mentioned in the scope and that it is prepared for additional families in the area covered.

The book is well illustrated with 212 black and white drawings of flies, larvae and their body parts. For this work no original figures were prepared but they were used from various standard works. Although all were excellent on their own, occasionally the combination of figures from different sources has led to reduced quality of one or two of the figures on a plate because the original were too diverse. However, this minor criticism is one of the very few to be made on the book.

The last two chapters of the book cover the list of references and the index. The list of references is excellent and provides a much needed review literature on the Malay Archipelago and covers a large amount of relevant literature from other regions. The index refers to all dipteran taxa mentioned in the text from family to species level, be it by scientific name or by vernacular name.

In all, Oosterbroek provides us with a much-needed introduction to the dipterous fauna of an area with a biodiversity of unknown wealth. This attractive book will prove to be just as indispensable for the Indo-Malaysian region as the larger works on the Nearctic and the Palaearctic faunas are for their regions. [P.L.Th. Beuk]

# SIXTEEN NEW SPECIES OF NEPOMORPHA (HETEROPTERA) MAINLY FROM SULAWESI (INDONESIA)

Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), VIII

Nieser, N. & P. P. Chen, 1999. Sixteen new species of Nepomorpha (Heteroptera) mainly from Sulawesi (Indonesia). – Tijdschrift voor Entomologie 142: 77-123, figs.1-135, tabels 1, 2. [ISSN 0040-7496]. Published 22 September 1999.

Representatives from the Nepomorphan families Belostomatidae, Corixidae, Helotrephidae, Micronectidae, Notonectidae, Ochteridae and Pleidae, mainly from Sulawesi, are discussed and, where appropriate, keys are provided. In addition, a table of species from Sulawesi and adjacent areas is provided and some comments on the biogeography of the infraorder in the area are given. The following new species are described: Micronectidae: *Micronecta kymatista* and *Micronecta pachynychi* from Sulawesi, *Micronecta aleksanderi* from Jawa, *Micronecta skutalis* from Sabah; Helotrephidae: *Helotrephes otoeis* from Sabah; *Hydrotrepes makros* and *Hydrotrepes mexon* from Sulawesi, *Hydrotrepes zetteli* from Sangir Is., *Hydrotrepes polhemi* from Flores, *Hydrotrepes pardalos* and *Hydrotrepes stereos* from Mindanao; Notonectidae: *Anisops rhomboides* from Sulawesi, Mindanao and Brunei, *Anisops salibabu* from Sulawesi and Talaud Is.; Ochteridae: *Ochterus homorfos* and *Ochterus trichota* from Sulawesi, *Ochterus pardalos* from Mindanao.

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Key words. – Nepomorpha, *Anisops*, *Helotrephes*, *Hydrotrepes*, *Micronecta*, *Ochterus* new species, keys; Indonesia, Sulawesi, Sangir I., Flores, Philippines, Mindanao, Malaysia, Sabah.

For the time being, this paper completes our treatment of Sulawesi Nepomorpha. The set of papers Nieser & Chen (1991, 1996 and the present one) provides an identification guide to all Sulawesi Nepomorpha species. There is little doubt, however, that a number of undescribed species are still to be discovered in Sulawesi for several families of Nepomorpha.

## MATERIAL AND METHODS

Measurements are in mm and are based on five specimens of each sex taken from the sample containing the holotype (if available). They are represented as the range of the sample with the sample mean in *italics*. Length and width refer to the maximum value of the specified body part oriented horizontally; if not specified they refer to body length and maximal body width. Body length is measured from anterior margin of vertex to apex of hemelytra. Extremities are measured with the ventral side upward, this is especially important in fore tibia of male *Micronecta*. The ocular index is computed as two times the synthlipsis (S)

divided by the difference between width of head (D) and synthlipsis, in formula:  $2S/(D-S)$ . This measurement buffers against peaks in the ratio synthlipsis/width of eye, due to imperfect orientation of the head. Where necessary, other measurements will be discussed under the separate families.

The areas in Sulawesi used in indication of the localities are the administrative provinces. Some additional data on the localities sampled by Nieser in 1989 (with numbers N89xx) can be found in Nieser & Chen (1991). Pulau Sangir is a spice island belonging to Sulawesi Utara province. As it lies some 200 Km N. of the northern point of 'mainland' Sulawesi it is not on the map used in this paper (fig. 126). Remarks between braces {} after the locality data contain additional information not found on the labels.

Abbreviations: brach. = brachypterous, macr. = macropterous; lvIV, lvV = 4th and 5th instar larva respectively; L = length, W is width.

Specimens have been deposited in the following

collections registered according to Arnett, Samuelson & Nishida (1993): BMKB (Kota Baru, Brunei Darussalam); JTPC (Englewood, Co. U.S.A.); MBBJ (Bogor, Indonesia); MUDH (The Hague, The Netherlands); NHMW (Vienna, Austria); NMSC (Singapore); OXUM (Oxford, UK); RMNH (Leiden, The Netherlands); SEMC (Lawrence Ka. U.S.A.); UPPC (Laguna, Philippines); USCP (Cebu City, Philippines); ZMAN (Amsterdam, The Netherlands).

Unregistered collections: KKUC (Khon Kaen University Entomological Collection, Thailand); NCTN (N. Nieser collection, Tiel, The Netherlands); NPSC (Collections of National parks of Sabah, Lahad Datu); UMSK (Collections of the Universiti Malaysia Sabah Kota Kinabalu); ZC (G. Zimmermann collection, Marburg, Federal Republic of Germany); ZCWA (Personal collection of H. Zettel, Vienna, Austria).

Specimens not specified are divided between the collection of the collectors (see acknowledgements) and NCTN.

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## SYSTEMATIC PART

### Family Micronectidae Jaczewski, 1924

Until recently, the Micronectidae have mostly been considered a subfamily of Corixidae, although some authors have considered them in the past to constitute a separate family. This started with Douglas & Scott (1865) using the name Sigaridae. Jones (1930) was the first to propose Micronectidae as a separate family under that name. This was followed by some authors, notably Poisson 1928-1938 (e.g. Poisson 1938a), who later reduced this taxon, without explanation, again to subfamily (Poisson 1938b). After 1948 the classification presented by Hungerford (1948) was generally followed, but at present there is a tendency to give this taxon family status again. This will be substantiated by Jansson et al. (in preparation).

The width of an eye in Micronectidae is measured along the posterior margin of the head.

The family Micronectidae consists of small to very

small Nepomorpha and is best represented in tropical and subtropical regions. There are at present three genera, *Tenagobia* Bergroth, 1899 in the New World; *Micronecta* Kirkaldy, 1897b and *Synaptonecta*, Lundblad 1933 in the Old World. Of these *Synaptonecta* contains only a few species whereas *Micronecta* and *Tenagobia* (respectively Wróblewski 1968 and Nieser 1977) contain a considerable number of species divided over several subgenera. Many species come to light and, especially in tropical Asian *Micronecta*, the ecology of many species is virtually unknown as they are mainly known from light catches.

The micronectid fauna of Australia (Wróblewski 1970) is quite different from that of the Malaysian Archipelago from Sulawesi westward, although some Australian species (e.g. *M. virgata*) reach Sulawesi. In addition there are some very widespread species (e.g. *M. ludibunda*, *M. quadristrigata*) which occur in both areas. The fauna of New Guinea is poorly known, but appears to be related to the Australian fauna. The micronectid fauna of the Moluccas is unknown. These practical restraints bring us to the following key to the Micronectidae from 'West Indonesia' covering the species of Indonesia from Sulawesi and Bali westward and including those of N. Borneo.

### Key to males of Micronectidae from 'West Indonesia'

1. Fore tibia and pala fused [S. India & Sri Lanka through Indochina to Jawa] ..... *Synaptonecta issa* (Distant, 1911) .....  
     ..... (syn: *S. breddini* Lundblad, 1933)
- Fore tibia and pala separated (*Micronecta*) ..... 2
2. Strigil absent ..... 3
- Strigil present ..... 6
3. Small species, length less than 2 mm, hemielytra not distinctly striped but with irregular marks which may be indistinct, right paramere relatively broad but not widened apically (fig. 31, 40) ..... 4
- Larger species, length 2 mm or more ..... 5
4. Smaller species, length 1.1-1.3 mm, left paramere distinctly narrowing apically (fig. 33) [Jawa] *M. acuta* Lundblad, 1933
- Larger species, length 1.7-1.8 mm, left paramere not narrowing apically (fig. 32) [Jawa] .....  
     ..... *M. aleksanderi* sp. n.
5. Length 2.0-2.1 (♀ 2.2-2.4), hemielytra dark with distinct longitudinal yellowish stripes which on corium are partly dissolved into yellow points, right paramere apically widened due to a thinner membranous triangular lobe on the convex margin of the shaft (fig. 41) [Jawa and Vietnam] *M. guttatostrigata* Lundblad, 1933
- Length 3 mm or more, hemielytral pattern indis-

- tinct, right paramere of the common evenly curved apically tapering type, left paramere as in fig. 44 [India through Vietnam to Taiwan, W. Malaysia and Sumatera] *M. grisea* (Fieber, 1844)
6. Very small species, length about 0.8 mm, right paramere apically forked (fig. 42) [Jawa] ..... *M. pumilio* Lundblad, 1933
- Larger species, length 1.5 mm or more ..... 7
7. Hemielytra light with dark purplish to black punctures [India and Sri Lanka through Indochina to Sumatera, Jawa and Bali] ..... *M. haliploides* (Horváth, 1904)
- Hemielytral pattern with darker stripes or patches but not punctuate ..... 8
8. Hemielytral pattern with distinct virtually continuous longitudinal stripes ..... 9
- Stripes on hemielytra, when present ill defined and interrupted ..... 11
9. Larger, usually macropterous, species, length 2.9–3.4 mm, left paramere apically spinose or scaly ..... 10
- Smaller species, length 1.5–2 mm, both macropterous and brachypterous forms common, left paramere with a flattened apex (fig. 46) [India and Sri Lanka through Indochina and Indonesia to New Guinea and Solomon Islands] ..... *M. ludibunda* Breddin, 1905
10. Left paramere apically constricted (fig. 18) right paramere apically as broad as or slightly broader than middle part of shaft [Solomon Is. through N. Australia to Sulawesi] ..... *M. virgata* Hale, 1922
- Left paramere apically slightly swollen (fig. 45), right paramere tapering apically [India and Sri Lanka through SE. Asia to Sumatera] ..... *M. siva* (Kirkaldy, 1844)
11. Free lobe of eighth abdominal tergite curved caudally in a sigmoid shape (fig. 5), right paramere slender, evenly curved (figs. 1, 43), length 2.2–3.1 mm ..... 12
- Free lobe of eighth abdominal tergite more or less straight, clavate, length 1.5–2.1 mm ..... 13
12. Length 2.2–2.9, hemielytral pattern in Sulawesi specimens faintly reticulate, number of bristles on inner margin of right half of eighth abdominal tergite 20–25 mostly in one row [Iran through India and Indochina to Philippines and N. Australia] ..... *M. quadristrigata* Breddin, 1905
- Length 2.8–3.1 mm, hemielytral pattern with interrupted longitudinal stripes, not reticulate, number of bristles on inner margin of right half of eighth abdominal tergite 28–35 mostly in a double or triple row, right [Sulawesi and Kalimantan] ..... *M. kymatista* sp. n.
13. Medio-caudal margin of free lobe of eighth abdominal tergite with three indistinct projections (fig. 48), apex of left paramere curved sideward (fig. 49) [West Malaysia, Sumatera, Jawa, ? Borneo] ..... *M. decorata* Lundblad, 1933
- Medio caudal margin of free lobe of eighth abdominal tergite curved with a single caudal point (fig. 9), apex of left paramere pointing straight upward, slightly serrate (fig. 17) ..... 14
14. Left paramere with a narrow shaft (fig. 17) ... 15
- Left paramere with a broad shaft (figs. 11, 25) ..... 16
15. Left paramere dark, paler claw with a small semicircular preapical incision but without subapical tooth (fig. 15) [Indochina, Sumatera, Jawa, Sulawesi] ..... *M. fugitans* Breddin, 1905
- Left paramere not darkened, paler claw subapically with sharp angle or tooth (fig. 16) [India and Sri Lanka through Viêt-Nam to Sulawesi] ..... *M. tarsalis* Chen, 1960
16. Smaller species, length 1.5–1.6 mm (♀ up to 1.7); paler claw not large or swollen (fig. 26); right paramere with a comparatively short and broad virtually straight shaft (fig. 24) [Sabah] ..... *M. skutalis* sp. n.
- Larger species, length 1.9–2.0 mm (♀ 2.0–2.1); paler claw large and swollen (fig. 13); right paramere with a comparatively longer and more slender, softly curved shaft (fig. 12) [Sulawesi Tengah] ..... *M. pachynychi* sp. n.
- Micronecta fugitans* Breddin**  
(figs. 15, 17)
- Micronecta fugitans* Breddin, 1905a: 57.  
*Micronecta fugitans*, Breddin 1905b: 157; Lundblad 1933: 91–93 (redescription).
- Material. – INDONESIA: Sulawesi Utara, Dumoga Bone N. P. Dumoga Bone Riv., flussabw. Brücke {downstream of bridge}, 22. X. 1985 5♂ 7♀ (NCTN); Base Camp, roadside puddle, 28 Oct. 1985, 2♂ 3♀; Tumpah Lichtfang {at light}, 28.x.1985, 1♀; Base Camp, Lichtfang {at light}, 4. XI. 1985, 1♀; all leg. G. Zimmermann, ZC unless otherwise indicated. – Sulawesi Tengah, 20 Km N. Palu, Fluß (stream), 10. II. 1995, 1♂ leg. Seifert & Greindl (66) (NHMW). – Sulawesi Tenggara, Sungai Sampara, 22. II. 1989, N8909, 1♂, leg. N. Nieser (NCTN). – Sulawesi Selatan, Salope, Wasserfall, 29. I. 1995, leg. Seyfert & Greindl (43), 3♂ 1♀ (2♂ 1♀ NHMW, 1♂ NCTN). – Jawa Timur, road Malang-Tretes, pool in irrigation stream, 5. VIII. 1983, N8358, 7♂ 8♀ 5lvV, leg. N. Nieser. All macropterous.
- Distribution. – Thailand, W. Malaysia, Sumatera, Jawa and Sulawesi.
- Micronecta grisea* (Fieber)**  
(fig. 44)
- Sigara grisea* Fieber, 1844a: 14.  
*Micronecta thyesta* Distant, 1911: 349.

*Micronecta thyesta*; Hutchinson 1940: 363-365 (redescription).

*Micronecta grisea*; Wróblewski 1968: 772-773, 775 (synonymy).

Material. – INDONESIA: Sumatera, Danau Toba, pond at YTP Arjuna Langakoti, 21. VII. 1994, leg. R. Thomas, 1 ♂ 1 ♀ macropterous. **First record for Sumatera.** – C. Sulawesi, 33.7 km SE Palu, 01°08' S 120°03'E, 800m, 19.xii.1994, lgt. Haft (4) 1 ♀ macr. (NHMW), males are needed to confirm the occurrence of this species in Sulawesi.

Distribution. – India, Sri Lanka, Vietnam, Taiwan, W. Malaysia, Sumatera, ?Sulawesi.

### *Micronecta haliploides* (Horváth)

*Sigara punctata* Fieber, 1844a: 15. Preoccupied by *Sigara punctata* Illiger, 1807 (currently *Corixa punctata*).

*Micronecta haliploides* Horváth, 1904: 57.

*Micronecta haliploides*; Lundblad 1933: 104-109 (redescription).

Material. – INDONESIA: Bali, Desa Sarokarya (near Sanur), ditch between agricultural fields, mainly rice but also vegetables, stagnant, many Poaceae, a few Lemnaceae and mats of Chlorophyta, 0.1-0.4 m deep, mud bottom, probably brackish with *Palaemonetes*-like prawns and small crabs, 10. VIII. 1983, N8364, leg. N. Nieser, 9 ♂ 35 ♀ brach., 10lvV. **First record for Bali.** – Jawa, Batavia, XI. 1907, leg. E. Jacobson, 1 ♀; Surabaya, XII. 1922, leg. P. Buitendijk, 1 ♂ 3 ♀ macr. (det. L. Chen, macr. RMNH). – Sumatera, Palembang, I. 1947, in de Moesi, leg. W. C. Verboom, 1 ♂ 2 ♀ (det. L. Chen, macr. RMNH); Jambi Prov. Simpang, at light, 29. IX. 1983, leg. J. M. Silvhus, 5 ♀ macr.

Distribution. – NE India, Sri Lanka, Thailand, Vietnam, W. Malaysia, Sumatera, Jawa, Bali.

### *Micronecta ludibunda* Breddin

(fig. 46)

*Micronecta ludibunda* Breddin, 1905a: 57.

*Micronecta ludibunda*; Breddin 1905b: 157-158; Lundblad 1933: 95-96 (redescription); Wróblewski 1968: 765-767 (redescription).

Material. – INDONESIA: Sulawesi Utara, Lakes, Kleiner See, Fischteich {Smaller Lake, fish pond}, 16. XI. 1985, 2 ♂ 7 ♀ (NCTN); Danau Alea, 22. XI. 1985, 1 ♀; leg. G. Zimmermann, (ZC). – Kalimantan Timur, Tanjung Isuy, 20. I. 1995, leg. Seyfert & Greindl (37), 1 ♂ (NHMW). – Jawa Barat, Bogor, Kebun Raya, largely open pond in botanical garden, some lotus plants at one edge. *Micronecta* both in the open and between plants, 29.vii.1983, N8349, leg. N. Nieser, 4 ♂ 9 ♀. All brachypterous.

Distribution. – India and Sri Lanka through SE

Asia, Jawa and Sulawesi to New Guinea and Solomon Is.

### *Micronecta quadristrigata* Breddin

(fig. 43)

*Micronecta quadristrigata* Breddin, 1905a: 57.

*Micronecta quadristrigata*; Breddin 1905b: 156-157; Lundblad 1933: 87-91 (redescription); Wróblewski 1972: 29-31 (redescription).

Material. – INDONESIA: Sulawesi Tenggara, Desa Kagunyal, pond overgrown by *Azolla* and *Lemna*, N8906, 21. II. 1989, 1 ♂ 1 ♀; pool at edge of marsh 20 Km S. of Pomalaa, N8927, 2. III. 1989, 1 ♀; pond at edge of marshy forest, N8929, 2. III. 1989, 1 ♂; sand pits at edge of marsh 20 Km S. Pomalaa, N8931, 2. III. 1989, 2 ♂ 2 ♀. – Sulawesi Selatan, Bantimurung, NO U.P. (25), 28. IV. 1992, leg. Schödl, 1 ♀ (NHMW). – Bali, Sesetan, shallow tributary of irrigation trench, depth to 0.15m, no vegetation, bare mud bottom, 10.viii.1983, N8365, 8 ♂ 6 ♀ 4 lvV; Road Sanur-Tohpati, km 4, small cattle pond, no vegetation except for a patch of marshy plants, up to 0.2m deep, loam/mud bottom, 11. VIII. 1983, N8366, 18 ♂ 27 ♀ 3 lvV; Stream crossing the road Sanur-Tohpati, shallow bay with sand bottom, no current, 11. VIII. 1983, N8367A, 15 ♂ 7 ♀; leg. N. Nieser. – Jawa Timur, sawah 8 km before Tretes, road Malang-treates, *Micronecta* in wet bed with rice seedlings, 5. VIII. 1983, N8357, 9 ♂ 12 ♀ 5lvV; Catchment area of Kali (river) Blawi, shallow muddy pool in dry stream bed, green algal bloom, 2. VII. 1994, N9460, 15 ♂ 13 ♀ 6lvV, leg. N. Nieser. Jawa Barat, Bogor, 11/12.vii. 1976 – 13/14. VIII. 1977, at light, P. H. van Doesburg, several thousands of exx. (RMNH, alcohol sample). – Sumatera, Jambi prov. Podok Simpang Berbak, at light, 29. IX. 1983, leg. J. M. Silvhus, 2 ♂ 5 ♀; Danau Toba, pond at YTP Arjuna Langakoti, 21. VII. 1994, leg. R. Thomas, 1 ♂ 2 ♀. – PHILIPPINES: Mindanao, Zamboanga, 17. VIII. 1952, at light, leg. L. D. Brongersma & W. J. Roosdorp, 37 ♂ 63 ♀ (det. A. Wróblewski, RMNH); Danau Mainit at Anibungan, irrigation ditch at marshy edge of lake, 26. III. 1993, N9324, leg. N. Nieser, 16 ♂ 16 ♀. All macropterous.

Distribution. – Widespread from Iran through S. and SE. Asia to Hong Kong and Taiwan, through Indonesia to Philippines and New Guinea. Apart from always being macropterous, a contributing factor to its wide distribution (and frequent collection) is that this species thrives in village ponds and rice-fields.

Remarks. – Very similar to *M. kymatista* sp. n., see key for differences between males, Sulawesi specimens of *M. quadristrigata* have a very slight tendency towards a reticulate hemielytral pattern lacking in *M. kymatista* which is also somewhat larger.

### *Micronecta siva* (Kirkaldy)

(fig. 45)

*Sigara striata* Fieber, 1844a: 292.

*Sigara siva* Kirkaldy, 1897a: 240.

*Micronecta siva*; Hutchinson 1940: 371-376 (redescription and synonymy).

Material. — INDONESIA: Sumatera, Palembang, in de Moesi (Musi River), I. 1947, leg. W. C. Verboom; surroundings of Palembang I. 1947 2♀ (det. L. Chen, RMNH); Sumatera, Danau Toba, pond at YTP Arjuna Langakoti, 21. VII. 1994, leg. R. Thomas, 1♀ (NCTN). All macropterous.

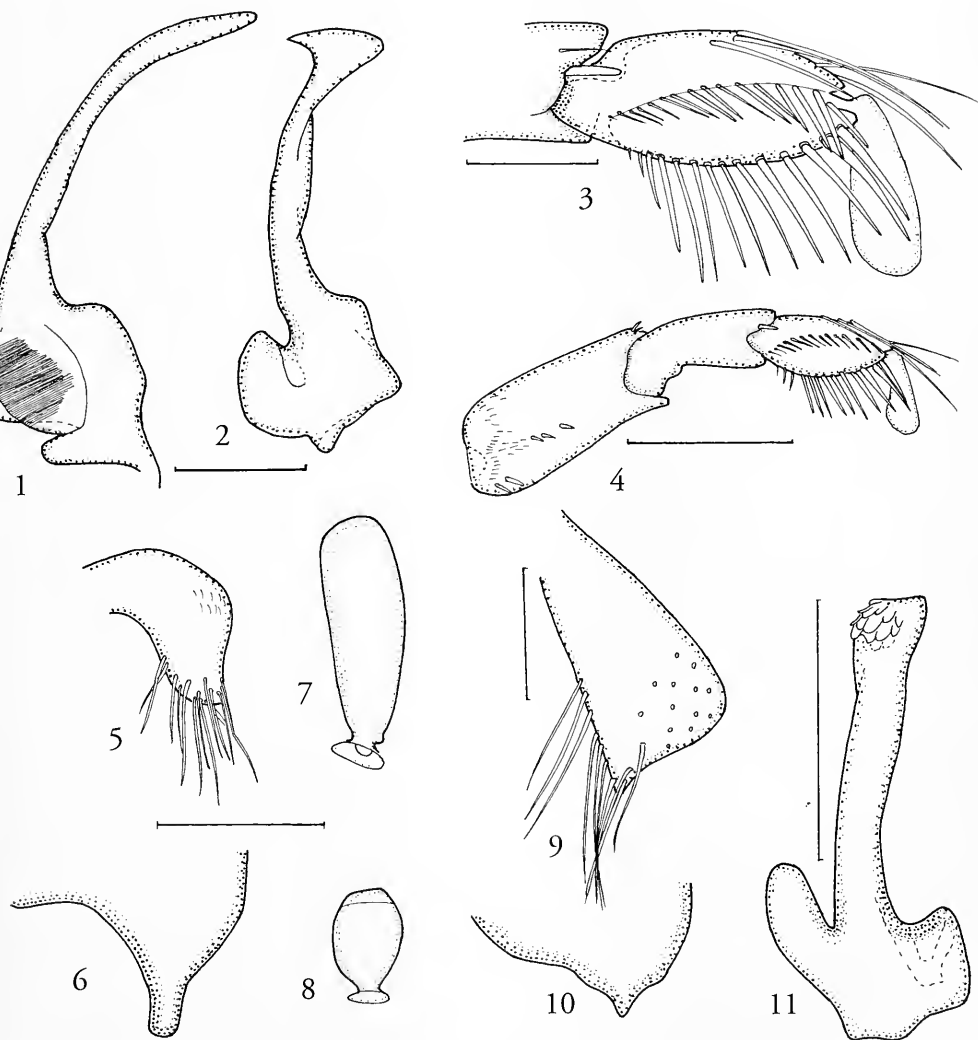
Distribution. — India, Sri Lanka, Myanmar, Vietnam, Sumatera, ?China.

Remarks. — The specimens from Musi River support the supposition of Hutchinson (1940) that 'the shallow water of larger rivers' might be an important habitat for this species.

***Micronecta tarsalis* L. C. Chen**  
(fig. 16)

*Micronecta tarsalis* L. C. Chen, 1960: 114.

*Micronecta tarsalis*; Wróblewski 1972: 40 (additional description).



Figs. 1-11. *Micronecta* spp., details. — 1-7, *M. kymatista*, paratype male: 1, right paramere; 2, left paramere; 3, pala; 4, fore leg; 5, free lobe of abdominal tergite 8; 6, outline of median lobe of abdominal sternite 7; 7, receptaculum seminis. — 8-11, *M. pachynychi*, paratypes (male, 8 female): 8, receptaculum seminis; 9, free lobe of abdominal tergite 8; 10, outline of median lobe of abdominal sternite 7; 11, left paramere. — Scales 1-3, 9-11: 0.1 mm; 4-8: 0.25 mm.

Material. – INDONESIA: Sulawesi Tenggara, Sungai Kolaka upstream of town, 27. II. 1989, N8921, leg. N. Nieser 1♂ (NCTN).

Distribution. – S. India, Sri Lanka, Vietnam, Sulawesi.

Remarks. – Males can be separated from *M. fugitans* by the tarsal characteristic (see key) and the lack of pigmentation of left paramere, females of *M. tarsalis* are slightly smaller, length 2.0 mm, whereas females of *M. fugitans* measure usually 2.1–2.2 mm.

### *Micronecta virgata* Hale

(fig. 18)

*Micronecta virgata* Hale, 1922: 327.

*Micronecta virgata*; Wróblewski 1962: 320–322 (redescription); Wróblewski 1970: 691–692 (additional description).

Material. – INDONESIA: Sulawesi Tenggara, Jalan Asera, overflowed banks of small stream, 24. II. 1989, N8918, 1♂ 2♀ macr. (NCTN).

Distribution. – Solomon Is., NE. Australia, Sulawesi.

Remarks. – Structural characteristics of the male and various measurements agree closely with *M. virgata* as interpreted by Wróblewski (1962, 1970), the only differences seem to be the metaxyphus which is relatively longer and more acute and the relative length of fore tibia and pala compared to fore femur, which are slightly less in the male of Sulawesi specimens compared to Australian ones. The relative length of the middle femur which is about 0.35 of body length in both sexes in Sulawesi specimens, whereas in Solomon Islands and Australian specimens this value is 0.41 and 0.38 respectively, so there may be a clinal variation in this ratio.

### *Micronecta kymatista* sp. n.

(figs. 1–7)

Type Material. – Holotype macropterous male (RMNH), INDONESIA: Sulawesi Utara, Dumoga Bone N.P., Malibagu Rd 10 km N, alt. ca 250m, 2 Sept. 1985, sec. growth, at light, leg. J. Huijbregts, HH437. – Paratypes: 89♂, 126♀: Same data as holotype 17♂ 18♀ (RMNH, 3♂ 2♀ NCTN). Dumoga Bone N.P., Tümpel am Institut {puddles near institute}, 26. X. 1985 3♂ 4♀ (ZC); Tumpah, Lichtfang [at light], 28.x.1985, 2♂ 3♀ (ZC); Base Camp, roadside puddle, 28 X. 1985, 12♂ 24♀ (NCTN), Base Camp, Lichtfang (at light), 4. XI. 1985, 20♂ 22♀ (NCTN); all leg. G. Zimmermann. Sulawesi

Utara, sawah, 10. XI. 1985, leg. G. Zimmermann, 2♂ 4♀ (ZC). – Sulawesi Tengah, Palu, 50 km SE, Lore Lindu N.P. Dongi sh., 950m, UTM SJ86, 9. XII. 1985, 1♂, at light, leg. Van Tol & Krikken (RMNH). – Sulawesi Tengah, Amapana, 1. II. 1995, (50), 1♂ 7♀; S. Palu, Fluß (stream), 27. I. 1995, (39), 1♂ 1♀; leg. Seyfert & Greindl (NHMW). – Sulawesi Tenggara, Wawonggo, Sungai Anggoro, N8901, 20. II. 1989, sluggish stream in open woodland, 12♂ 18♀ (1♂ ZMAN); Desa Kagunyala, pond overgrown by *Azolla* and *Lemna*, N8906, 21. II. 1989, 3♂ 4♀; Desa Kagunyala, pond with some *Lemna*, N8907, 21. II. 1989, 2♂ 1♀; Jalan Asera, pond in meadows, N8917, 24. II. 1989, 5♀; flooded banks of stream crossing Jalan Asera, N8918, 24. II. 1989, 2♂ 5♀; Sungai Kolaka, N8921, 27. II. 1989, 4♂ 3♀; pool at edge of marsh 20 Km S. of Pomalaa, N8927, 2. III. 1989, 1♀; small stream in marsh, 20 km S. Pomalaa, 2. III. 1989, 1♀. Pulau Buton, Desa Gareng Gareng, pond with fish, N8936, 8. III. 1989, 1♀; same, pond with few fish, N8937, 8. III. 1989, 1♂; mangrove swamp along road Bau Bau to Lawele, N8939, 9. III. 1989, 4♂ 5♀. NCTN unless otherwise indicated. – Sulawesi Selatan, Malino-Manipi, 700m, 1. V. 1992, 1♂ leg. Jäch (31) (NHMW). – Kalimantan Timur, Tanjung Isuy, 20. I. 1995, 1♂, leg. Seifert & Greindl (37) (NHMW). All macropterous.

### Description

Macropterous specimens. Dimensions. Length ♂ 2.80–2.88–2.90, ♀ 2.92–3.06–3.12; width ♂ 1.25–1.30–1.32, ♀ 1.28–1.33–1.39; width of head ♂ 1.01–1.02–1.03, ♀ 1.04–1.08–1.11; synthlipsis ♂ 0.39–0.40–0.41, ♀ 0.41–0.41–0.42; width of an eye ♂ 0.30–0.33–0.35, ♀ 0.33–0.35–0.38; width of pronotum ♂ 0.98–1.00–1.01, ♀ 1.02–1.05–1.08.

Colour. Dorsally pale greyish brown, eyes darker grey, head, venter and legs yellowish with some fringes of bristles and claws of hind tarsi usually dark brown. Hemelytra with hyaline stripes at base of clavus and inner side of right corium as usual in genus; embolium yellowish. Dark pattern of hemelytra similar to other species of the *M. quadristrigata*-group especially *M. altera* Wróblewski; costal margin with two elongate dark patches, one at about basal third of corium, one halfway membrane of right hemelytron; left membrane hyaline with entire margin infuscate. Clavus with dark stripe along lateral margin and some smaller diffuse patches but pattern often indistinct; corium with four longitudinal stripes, the first (most lateral) and third long, second and fourth short, first caudally hooked.

Ratio length/width of body ♂ 2.1–2.2–2.3 ♀ 2.2–2.3–2.4. Head slightly wider than pronotum, synthlipsis distinctly wider than posterior width of an eye,

ocular index ♂ 1.25-1.29-1.32 ♀ 1.17-1.24-1.30. Pronotum dorsally convex, about thrice as wide as long (W/L ♂ 2.9-3.0 ♀ 2.6-2.8). Hemelytra with distinct scattered short spines. Lobes of abdominal tergite 4 with 10 bristles each. Spines laterally on abdominal segments: IV and V 2 short, 1 long; VI and VII 2 or 3 short, 1 longer; VIII 5 or 6 short, 1 long. Leg measurements summarized in table 1.

Male fore leg (fig. 4); femur with a pair of basal bristles, a central and an apical pair of small spines; tibia with an apical spine. Pala (fig. 3) with 5 long dorsal hairs, palm with about 15 bristles each in dorsal and ventral rows, claw broadly clavate, without ventral notch. Abdomen, prestigilar flap poorly differentiated, strigil small, length 44-62µ, relatively broad, 1 comb with about 50 elongate teeth, median lobe of seventh abdominal sternite narrow with a rounded apex (fig. 6). Free lobe of left part of segment 8 as in fig. 5; plectrum on right part of segment 8 with 50-75 ribs, 28-35 marginal hairs along inner margin between plectrum and apex of right part of segment 8, anteriorly in one row posteriorly in a double to triple row. Right paramere (fig. 1) as in *M. quadristrigata*; in median view with the shaft more distinctly undulate, about 40 ribs on pars stridens process. Left paramere as in fig. 2.

Female fore leg with essentially the same pattern of spines and bristles as in male, the apical pair of tibial spines indicates the border between tibia and pala, the number of palar bristles in ventral row is somewhat lower, 10-12. Receptaculum seminis (fig. 7) simple, clavate.

### **Etymology**

Kymatistos, Greek adjective meaning sinuous, referring to the sinuous free lobe and shaft of right paramere in inner view, typical for this and closely related species.

### **Comparative notes**

(see also Wróblewski 1972)

The form of the free lobe of left part of abdominal segment VIII in males and the left paramere place this species in the *M. quadristrigata*-group. Size and the number of hairs on apical half of inner margin of right part of abdominal segment VIII with *M. altera* Wróblewski and *M. quadristrigata* f. *minthe* Distant from continental S. and SE. Asia. *M. altera* has the right paramere different with basal part of shaft slightly but distinctly swollen and a smaller number of plectral ribs (40-45). *M. quadristrigata* f. *minthe* of which the lectotype (Wróblewski 1972) was studied has the right paramere identical but the strigil is longer (72-85µ) with shorter teeth thus appearing distinctly more elongate and has more ribs (about 100) on the plectrum in addition in *M. kymatista*

tarsal segment II is relatively longer than in *M. quadristrigata* f. *minthe* (0.37 and 0.32 times the length of femur respectively). *M. quadristrigata* finally which has also virtually identical parameres, is smaller, has less bristles in caudal half of inner margin of tergite 8 of male (20-25) and less plectral ribs (about 50). Apparently there is an ecological difference too. *M. quadristrigata* has nearly exclusively been found in ponds in cultivated or otherwise strongly disturbed areas whereas *M. kymatista* has been collected mostly in less disturbed areas.

### ***Micronecta pachynychi* sp. n.**

(figs. 8-14, 19)

Type Material. – Holotype, macropterous male: INDONESIA: Sulawesi Tengah, Batui River, SW of Luwuk, Toptop Camp, 1°09'S, 122°31'30"E, 120m, 19 Oct. 1989, lowland rainforest, at light, J. P. Dufels, sample Sul.19 (ZMAN). – Paratypes, same data as holotype 34♂ 59♀ all macropterous, distributed as follows: 23♂ 48♀ (including allotype) ZMAN, 1♂ 2♀ MBBJ, 8♂ 8♀ NCTN, 1♂ 1♀ NHMW, 1♂ 1♀ RMNH.

### **Description**

Macropterous specimens. Dimensions. Length ♂ 1.92-1.98-2.03, ♀ 2.02-2.05-2.08; width ♂ 0.92-0.94-0.95, ♀ 0.90-0.96-1.00; width of head ♂ 0.66-0.70-0.71, ♀ 0.70-0.71-0.71; synthipsis ♂ 0.28-0.29-0.30, ♀ 0.29-0.30-0.31; width of an eye ♂ 0.22-0.23-0.25, ♀ 0.20-0.22-0.23; width of pronotum ♂ 0.72-0.74-0.75, ♀ 0.74-0.75-0.77.

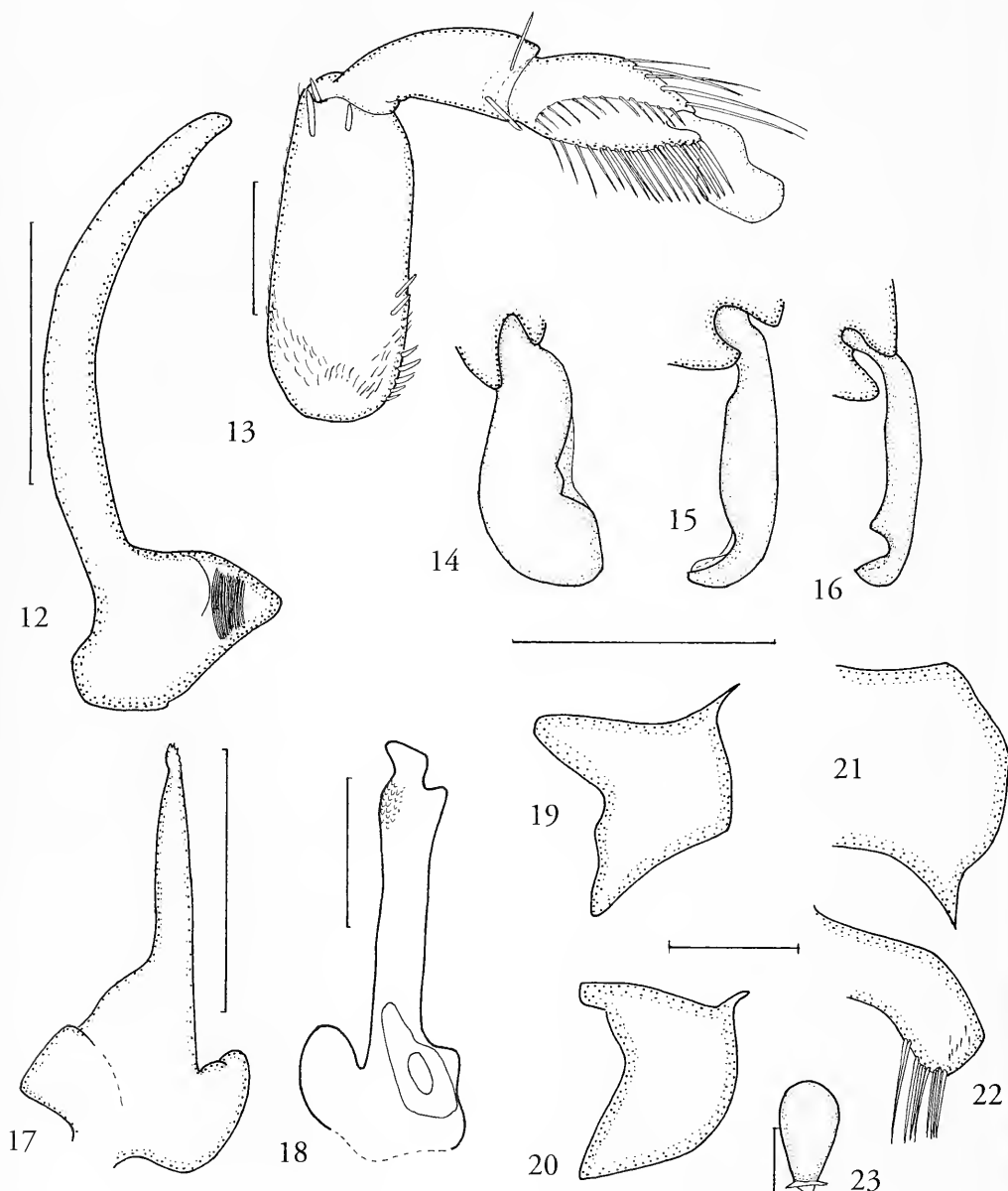
Colour. Dorsally light to medium brown, eyes grey, head, legs, posterior margin of pronotum and embolium yellowish, ventral side medium to dark brown. Pronotum shining, unmarked except for lighter posterior margin and lateral angles, hemelytra shining, with usual hyaline stripes, darker marks indistinct or absent, left membrane smoky.

Ratio length/width of body ♂ 2.0-2.1-2.2 ♀ 2.1-2.2-2.2. Head slightly narrower than pronotum, synthipsis distinctly wider than posterior width of an eye, ocular index ♂ 1.41-1.46-1.50 ♀ 1.35-1.48-1.55. Pronotum dorsally convex, about two and a half times as wide as long (W/L ♂, ♀ 2.3-2.5). Hemelytra smooth without scattered short spines. Lobes of abdominal tergite 4 with 12-14 bristles each. Spines laterally on abdominal segments: IV and V 2 short, 1 long; VI and VII 2 or 3 short, 2 long; VIII 5 or 6 short, 2 very long, hair-like. Leg measurements summarized in table 1.

Male, fore leg (fig. 13); femur with a pair of basal bristles, a central and an apical pair of small spines; tibia with an apical spine. Pala with 5 long dorsal hairs, palm with 12-14 bristles in dorsal and about 17

in ventral row, claw very broad (fig. 14). Abdomen, prestigilar flap with inner caudal angle rather narrow (fig. 19), strigil small, 1 comb with about 50 elongate teeth, median lobe of seventh abdominal sternite rather short (fig. 10). Free lobe of left part of segment

8 clavate with about ten apical bristles (fig. 9); plectrum on right part of segment 8 with about 50 ribs (very fine and difficult to count at magnification of 400 $\times$ ), 8 marginal hairs in one row along inner margin between plectrum and apex of right part of seg-



Figs. 12-23. *Micronecta* spp., details. – 12-14, *M. pachynychi* paratype male: 12, right paramere; 13, fore leg; 14, tarsal claw; 15, *M. fugitans*, tarsal claw of male; 16 *M. tarsalis*, ditto; 17, *M. fugitans*, left paramere; 18, *M. virgata*, ditto; 19, *M. pachynychi*, paratype, prestigilar flap; 20-23, *M. skutalis*, paratypes (male, 23 female): 20, prestigilar flap; 21, outline of median lobe of abdominal sternite 7; 22, free lobe of abdominal tergite 8; 23, receptaculum seminis. – Scales 0.1 mm.

ment 8. Right paramere (fig. 12) with an evenly curved shaft, about 25 ribs on pars stridens. Left paramere with scale-like structures apically (fig. 11).

Female fore leg with essentially the same pattern of spines and bristles as in male, the apical pair of tibia indicates the border between tibia and pala, the number of palar bristles in dorsal row is somewhat lower, 10-12. Receptaculum seminis (fig. 8) simple, semi-globular.

### Etymology

Pachynychi a composite Greek noun meaning 'thick nail' or 'thick claw' referring to the palar claw of the male.

### Comparative notes

The thick palar claw in combination with the scaly left paramere is characteristic. Australian species with thick claws such as *M. annae* Hale and *M. gracilis* Hale and Asian species with scaly left paramere such as *M. sedula* Horváth and *M. orientalis* Wróblewski are larger, length about 3 mm (Wróblewski 1960, 1970).

### *Micronecta aleksanderi* sp. n.

(figs. 31, 32, 34-39)

Type Material. – Holotype, macropterous male (RMNH), INDONESIA, Jawa Tengah, stream upstream of Baturraden at waterfall, 1 Aug. 1983, small bay, hardly any current, bottom coarse dark sand, N8354C, leg. N. Nieser. – Paratypes: 2♂ and 5♀ same data as holotype, ♀ allotype in RMNH, rest in NCTN. – Jawa Timur, mountain stream upstream of Tretes, *Micronecta* from pool with coarse sand bottom, 6. Aug. 1983, N8360, 1♂ on 2 microscopic slides; road Malang-Tretes, pool in irrigation stream, 5. VIII. 1983, N8358, 1♀, both leg. N. Nieser (NCTN).

### Description

Macropterous specimens. Dimensions. Length ♂ 1.70-1.81-1.82, ♀ 1.77-1.80-1.83; width ♂ 0.85-0.88-0.90, ♀ 0.90-0.91-0.92; width of head ♂ 0.63-0.65-0.70, ♀ 0.67-0.68-0.68; synthlipsis ♂ 0.30-0.31-0.31, ♀ 0.32-0.33-0.33; posterior width of an eye ♂ 0.18-0.19-0.20, ♀ 0.20-0.21-0.22; width of pronotum ♂ 0.68-0.70-0.71, ♀ 0.28-0.30-0.31.

Colour dorsally generally light brown, eyes blackish, venter yellow, head, posterior margin of pronotum and legs pale yellow. Hemelytra apparently light brown with vague darker markings: two dark patches on embolium, a caudally hooked longitudinal stripe laterally on corium and an apical patch in caudal angle of clavus. Hyaline patches on hemelytra as usual in genus.

Head slightly narrower than pronotum, synthlipsis distinctly wider than posterior width of an eye, ocular index ♂ 1.50-1.79-2.00, 1.83-1.87-1.89, eyes relatively small. Lateral margin of pronotum well developed, caudally divergent. Hemelytra with numerous, evenly dispersed, very small spines. Lobes of abdominal tergite 4 with 10 bristles each. Spines laterally on abdominal segments: IV 1 short (and 1 longer bristle), V 2-3 short, 1 long; VI 2 short 2 long, VII 3 short 2 long; VIII 3 short, 2 very long, hair-like. Leg measurements summarized in table 1.

Male, fore leg (fig. 38); femur with two spines in basal part, one dorsally in apical third and two apically; tibia with three spines ventrally in distal third; pala (fig. 39) with four long dorsal hairs, palm with 15 short bristles in dorsal and 12 longer bristles in ventral row, claw large, simple, clavate. Abdomen, prestigular lobe as in fig. 35, strigil absent, median lobe of seventh abdominal sternite short and acute (fig. 36). Free lobe of left part of segment 8 parallel-sided with outer angle accentuated and bearing 12 apical bristles (fig. 34); plectrum on right part of segment 8 with about 20 ridges; 6 marginal hairs in one row along inner margin between plectrum and apex of right part of segment 8, restricted to caudal part of margin. Right paramere (fig. 31) rather solid, pars stridens with 15 coarse ribs. Left paramere with a broad apex and a large ventral lobe (fig. 32).

Female fore leg with essentially the same pattern of spines and bristles as in male. Receptaculum seminis (fig. 37) simple, clavate.

### Etymology

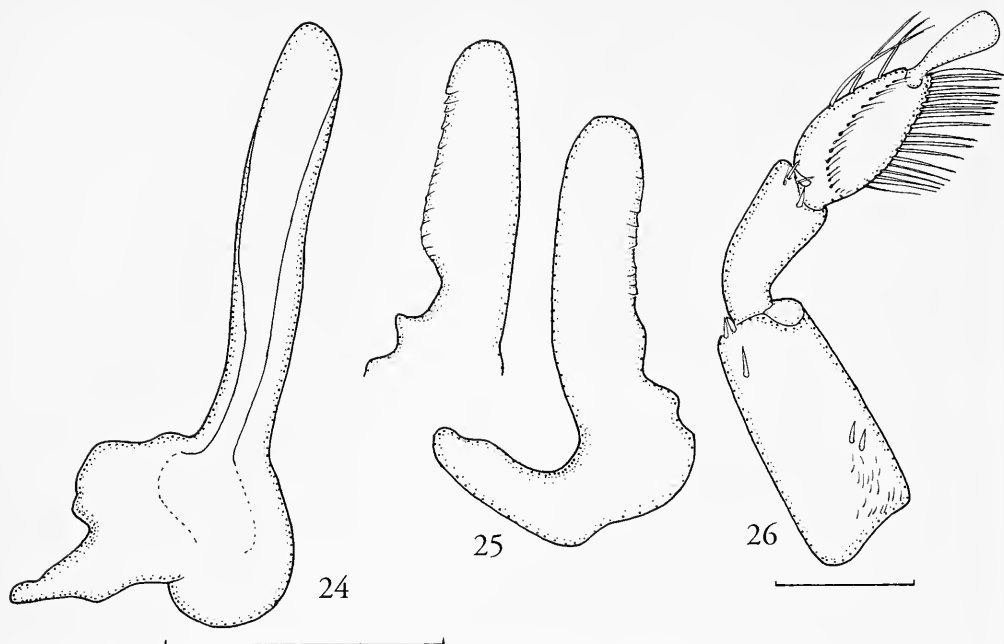
Dedicated to our colleague Prof. Aleksander Wróblewski, who recognized this species as undescribed but was unfortunately not able to prepare the description.

### Comparative notes

Similar to *M. acuta* Lundblad (1934a) not only for lacking a strigil in the male but also agreeing in having small eyes, similar general shape, male fore leg and right paramere. Differences are in size, length of *M. acuta* 1.1-1.3 mm and the form of left paramere which in *M. acuta* has a distinctly tapering apex (fig. 33). There may be an ecological difference too as *M. acuta* has been found among plants and *M. aleksanderi* in pools without vegetation and a coarse sand bottom.

### Remarks

Three males and three females from the same sample as the holotype and one male and female from sample N8360, were being studied by Prof. Wróblewski when he had to stop working due to his illness. They have not been found when the material



Figs. 24-26. *Micronecta skutalis*, paratype male. – 24, right paramere; 25, two different views of left paramere; 26, fore leg.

was requested back and are probably still somewhere in the collection of the Zoological Institute in Poznań.

***Micronecta skutalis* sp. n.**  
(figs. 20-26)

**Type Material.** – Holotype, macropterous male (RMNH), EAST MALAYSIA, Sabah, 60 km W of Lahad Datu, Danum Valley Field Centre at junction Sg. Segama and Sg. Palum Tambun, bridge of Segama, 4°58'N 117°48'E, 750 m, edge of untouched lowland rain forest, 14. march 1987, at light, 18.20-22.30h, leg. van Tol & Huisman. – Paratypes: 23♂ 39♀: same data as holotype, 16♂ 15♀ including allotype ♀ (3♂ 3♀ NCTN, 1♂ 1♀ ZMAN); same locality, clearing near E trail, edge of untouched lowland rain forest, 21. III. 1987, at light, 18.30-22.30h, leg. van Tol & Huisman, 5♂ 12♀ (1♂ NCTN). Sabah, 60 km W of Lahad Datu, Danum Valley Field Centre Sg. Palum Tambuni, 117.48E 4.58N, 150m asl., 9. IX. 1986, UV-light, 2♂ 12♀, leg. J. Huisman. All macropterous, in RMNH unless otherwise indicated.

**Description**

Macropterous specimens. Dimensions. Length ♂ 1.46-1.52-1.56, ♀ 1.50-1.61-1.67; width ♂ 0.59-0.62-0.65, ♀ 0.63-0.94-0.68; width of head ♂ 0.51-

0.52-0.53, ♀ 0.53-0.55-0.56; synthlipsis ♂ 0.20-0.22-0.24, ♀ 0.22-0.23-0.25; width of an eye ♂ 0.15-0.17-0.19, ♀ 0.16-0.18-0.21; width of pronotum ♂ 0.54-0.58-0.60, ♀ 0.56-0.58-0.60.

**Colour.** Dorsally light to medium brown, eyes grey, head, legs, posterior margin of pronotum and outer margin of embolium yellowish, ventral side medium to dark brown. Pronotum shining, unmarked except for lighter posterior margin and lateral angles, hemielytra shining, with usual hyaline stripes, darker marks indistinctly arranged in three interrupted longitudinal stripes, left membrane hyaline with outer half smoky.

Ratio length/width of body ♂ 2.3-2.42.6 ♀ 2.3-2.5-2.6. Head slightly narrower than pronotum, synthlipsis distinctly wider than posterior width of an eye, ocular index ♂ 1.29-1.441.71 ♀ 1.42-1.52-1.71. Pronotum dorsally convex, two to two and a half times as wide as long (W/L ♂,♀ 2.1-2.7). Hemielytra with short spines which are arranged in longitudinal rows and along the membranal suture. Lobes of abdominal tergite 4 with 5-6 bristles each. Spines laterally on abdominal segments: IV 1 short 1 longer, V 2 short, 1 long; VI 2 short 1-2 longer, VII 2 short 2 long; VIII 5 short, 2 very long, hair-like. Leg measurements summarized in table 1.

Male, fore leg (fig. 26); femur in basal part with 2 and apically with 2-3 small spines; tibia with 2-3 small spines near distal margin; pala with 3 long dor-

sal hairs, palm with 15-19 bristles in dorsal and 14-17 in ventral row, claw simple, clavate. Abdomen, prestigilar lobe as in fig. 20, strigil small, 1 comb with about 60 long and narrow teeth, median lobe of seventh abdominal sternite rather short (fig. 21). Free lobe of left part of segment 8 clavate with about ten apical bristles (fig. 22); plectrum on right part of segment 8 without ribs (at least not visible at magnification of  $400\times$ ), 10-14 marginal hairs in one row along inner margin between plectrum and apex of right part of segment 8. Right paramere (fig. 24) with a rather broad, nearly straight shaft, ribs on pars stridens not visible at a magnification of  $400\times$ . Left paramere with scale-like structures along one side (fig. 25).

Female fore leg with essentially the same pattern of spines and bristles as in male. Receptaculum seminis (fig. 23) simple, clavate.

### **Etymology**

Skutalis, Greek noun meaning baton, referring to the rod-like appearance of the right paramere.

### **Comparative notes**

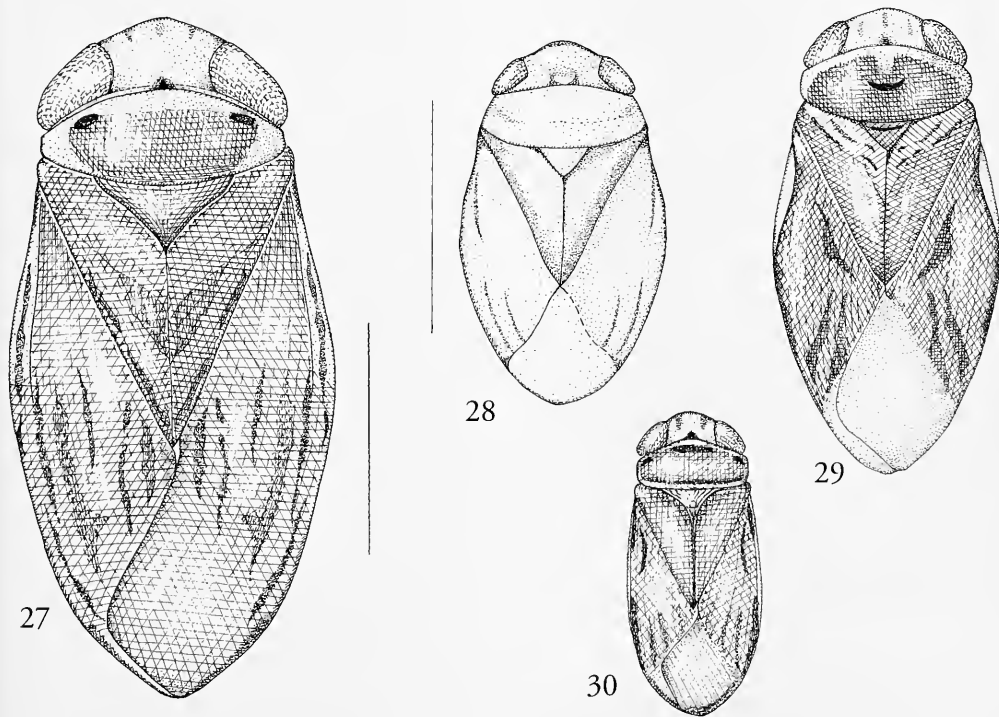
The left paramere is similar to that of *M. daedala*

Distant (1911), *M. hummeli* Lundblad (1934a) and *M. poci* Wróblewski (1967). Of these *M. poci* has a very aberrant apex of the right paramere (fig. 46). *M. daedala* and *M. hummeli*, which are closely related, are somewhat larger (length 1.8-2.0 mm) and have the apex of the right paramere geniculate apically.

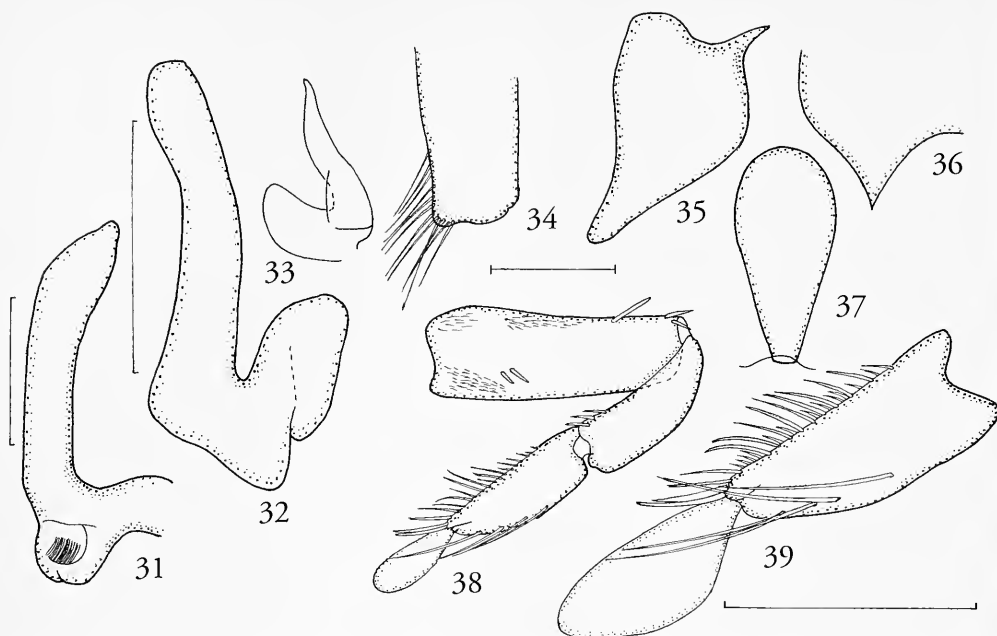
### **Family Corixidae Leach, 1815**

The Corixidae s. str. are very poorly represented in our study area, in fact in all true tropical regions. The latter with the exception of the halophilous species of the neotropical genus *Trichocorixa*. One of the reasons for this difference in distribution between Corixidae and Micronectidae may be that Corixidae, due to their larger size, are more prone to fish predation and various kinds of small water bodies in the tropics are much more often infested by fish. Negative correlation between occurrence of fish and Corixidae is well known (e.g. Bendell & McNicol 1995).

Only two genera are so far known to occur in the Malaysian Region. They can be easily separated by the following key:



Figs. 27-30. Habitus of new *Micronecta* species. – 27 *M. kymatista*, paratype male; 28 *M. aleksanderi*, holotype male; 29 *M. pachynychi*, paratype male; 30 *M. skutalis*, paratype male. – Scales 0.1 mm.



Figs. 31-39. *Micronecta* spp., details. – 31, 32, *M. aleksanderi*, paratype; 31, right paramere; 32, left paramere; 33, *M. acuta*; left paramere (after Lundblad 1933, not on scale). – 34-39, *Micronecta aleksanderi*, paratype male, paratype female (37). – 34, free lobe of abdominal tergite 8; 35, prestigilar flap; 36, outline of median lobe of abdominal sternite 7; 37, receptaculum seminis; 38, fore leg; 39, pala and palar claw. – Scales 31-32, 34-39: 0.1 mm.

1. Pronotum and hemielytra unicolorous, hyaline brownish ..... *Agraptacorixa* Kirkaldy, 1898
- Pronotum and usually hemielytra marked with transverse alternating yellow and dark bands (which may be fragmented or vermiculate) .....  
..... *Sigara* Fabricius, 1775

So far only two species of *Sigara* found in Indonesia. *Sigara* (*Tropocorixa*) *connexa* Lundblad (1933) is known from Indochina, Sumatera and Jawa (Jaczewski 1962). *Sigara* (*Tropocorixa*) *insulana* Lundblad, 1933 has been described from mountainous areas in Jawa and Sumatera and never been recorded again.

***Agraptacorixa hyalinipennis* (Fabricius)**  
(figs. 50, 51)

*Sigara hyalinipennis* Fabricius, 1803: 105  
*Agraptacorixa hyalinipennis* Jaczewski 1926: 18-21; 1962: 467.

Material. – INDONESIA: Maluku, Bacan, Wayaua, ca. 50m asl., logged forest & camp, hand coll., 05-16.viii.1985, 1♂, leg. J. Huijbregts (RMNH). **First records from the Moluccas.** – PHILIPPINES: Mindanao, Lake Sebu area, barangay Bakdolong, pools on banks of stream, 3.xii.1993,

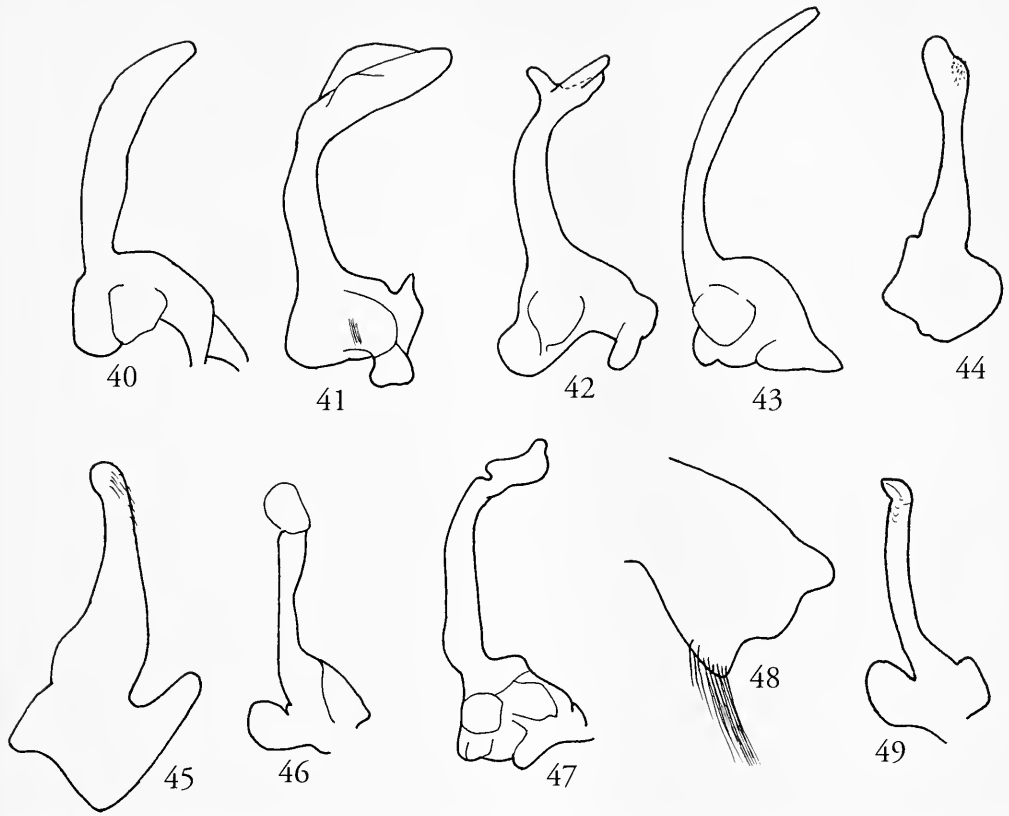
N9365, 1♀, leg. N. Nieser (NCTN); to be entirely sure the record has to be confirmed by male specimens from the area. **First record from the Philippines.**

Distribution. – India, Myanmar, Taiwan, Indonesia (Sumatera, Jawa, Maluku), Philippines (Mindanao) and Papua New Guinea.

Remarks. – In view of its distribution this species might turn up in Sulawesi. It is smaller than its Asian congeners, which measure over 8.5 mm. In the Australian fauna there are several species of approximately the same size (6.5-8 mm); these all have distinctly different right paramere and strigil (figs. 50, 51), notably *A. macrops* Hungerford which occurs also in New Guinea has a small strigil which is not on a stalk (Knowles 1974). So far Australian species are not known to occur West of New Guinea.

**Family Ochteridae Kirkaldy, 1906**

The Ochteridae form a small family with at present three genera of which *Ochterus* Latreille occurs worldwide in tropical and subtropical regions. The other genera contain few species and are restricted to Australia and S. America. S. America and the Australian Region are relatively rich in species, elsewhere the number of species is low (Baehr 1990b, Kormilev



Figs. 40-49 *Micronecta* spp.: male parameres (40-43, 47 right; 44-46, 49, left), and male free lobe of eighth abdominal tergite (48). – 40 *M. acuta*; 41 *M. guttatostrigata*; 42 *M. pumilio*; 43 *M. quadristrigata*; 44 *M. grisea*; 54 *M. siva*; 46 *M. ludibunda*; 47 *M. pocsi*; 48, 49, *M. decorata*. – 40; 42; 43; 46; 48, 49 after Lundblad (1933); 41, 47 after Wróblewski (1967); 44 after Wróblewski (1972) and 45 after Hutchinson (1940).

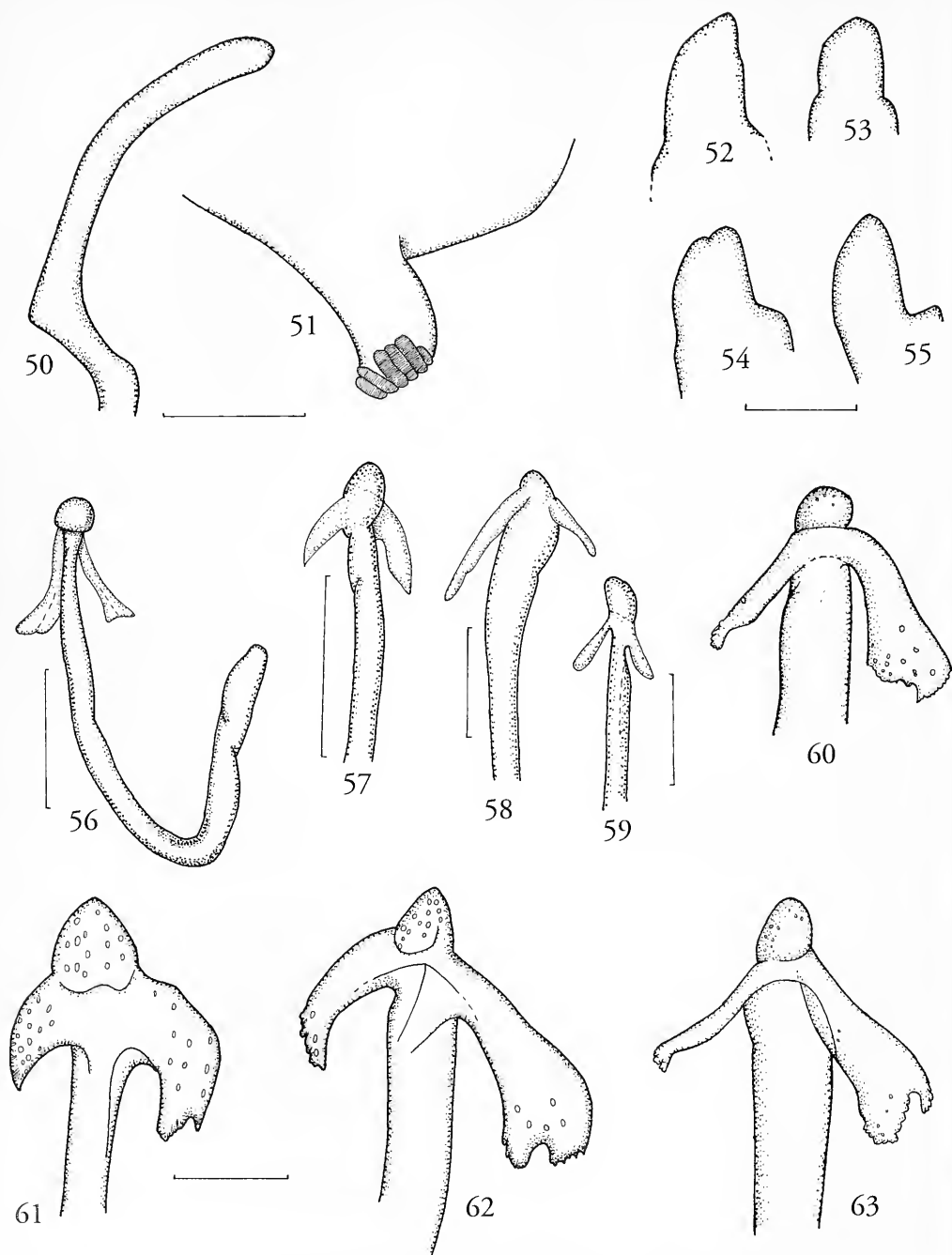
1971 & 1973, Nieser & Chen 1992a, Schell 1943). However, recently Gapud (1981, 1995) and Gapud & San Valentin (1977) found several undescribed species in the Philippines, so the low number of species in some areas may be due to insufficient collecting. Sulawesi is with five species intermediate between the species-poor African-Continental Asian area and the rich Australian area.

Species of *Ochterus* are usually reported to live at the edge of water mostly on open spaces and as a rule at exposed sunny places. However, this is partly due to the fact that most reports refer to the widespread species *O. marginatus*. At least in the tropics, several species occur regularly on shaded sandy banks of streams in forests. They are agile insects which fly quickly when disturbed. As Jaczewski (1935) observed their habitat boosts the possibility that they escape the collecting activities of most hydrobiologists and also the students of terrestrial fauna.

Not only is the fauna of New Guinea and Australia richer than that of more western parts of Asia, the actual species composition is also different. Even the very widespread *O. marginatus* is not known to reach New Guinea. Due to this difference in fauna the key below refers to the species known from Indonesia excluding Irian Jaya but, for the sake of geographical continuity, including N. Borneo. The fauna of New Guinea is treated in Baehr (1990b).

#### Key to West Indonesian species of *Ochterus*

1. Large species, length ( $\sigma$ ) 5.0 – ( $\text{♀}$ ) 5.5, costal margin of hemielytra narrowly yellowish without broader more or less square patches, appendages of right paramere rather broad with pointed tips (fig. 57) [Sulawesi Tenggara] .....  
..... *O. grandiusculus* Nieser & Chen, 1992



Figs. 50-63. Corixidae and Ochteridae. – 50, 51., *Agraptacorixa hyalinipennis*, from Bacan; 50, right paramere; 51, strigil. – 52-55, apex of pygophore of *Ochterus* spp.: 52, *O. noualhier*; 53, *O. pardalos*, holotype; 54, *O. homorfos*, paratype; 55 *O. trichotos*, holotype; 56 *Ochterus marginatus* right paramere; 57-63, apex of right paramere of *Ochterus* spp.: 57, *O. grandiusculus*; 58, *O. thienemanni*; 59, *O. xustos*; 60, *O. noualhier*; 61, *O. homorfos*, paratype; 62, *O. trichotos*, holotype; 63, *O. pardalos*, holotype. – Scales 50, 51: 0.25 mm; 52-55: 0.5 mm; 56-59: 0.2 mm; 60-63: 0.1 mm.

- Smaller species, length up to (♂) 4.8 – (♀) 5.2, eventual larger specimens with some square yellow patches along costal margin and appendages of right paramere long, apically indented (fig. 56) ..... 2
- 2. Pronotum scutellum and basal half of hemielytra covered with long (0.10-0.15 mm) erect hairs [Sulawesi Selatan] ..... *O. trichotos* sp. n.
- Body at most with much shorter appressed hairs ..... 3.
- 3. Dark species, colour pattern variable but nearly always hemielytra dark grey to blackish, costal margin of hemielytra narrowly yellowish with proximal part of embolium and 2-3 square patches on corium broader yellowish, posterior margin of pronotum narrowly yellowish, a broader patch in the middle; appendages of right paramere approximately symmetrical, slender, apically indented and usually rather long (fig. 56) [widespread] ..... *O. marginatus* (Latreille)
- Hemielytra brown to blackish without the square yellowish patches along costal margin of corium, lighter mark on median part of posterior margin of pronotum as a rule not distinctly wider than the more lateral yellowish stripe on posterior margin ..... 4
- 4. Proximal segments 1 and 2 of rostrum dark brown to black ..... 5
- Proximal segments 1 and 2 of rostrum yellowish to light brown ..... 6
- 5. Smaller species, length 4-4.5 mm, apical part of shaft of right paramere swollen (fig. 58) [Sumatera, Jawa, Bali] ..... *O. thienemanni* Jaczewski, 1935
- Larger species, length 4.2-4.8 mm, apical part of shaft of right paramere not swollen (fig. 61) [Sulawesi Tengah and S. Utara] .... *O. homorfo* sp. n.
- 6. Hemielytra light to medium brown; right paramere with distinctly asymmetrical appendages of which the right one is distinctly incised apically (fig. 60) [Jawa, Sulawesi] ..... *O. noualhierii* Baehr
- Hemielytra dark brown to blackish; appendages of right paramere virtually symmetrical with slightly rounded (not incised) apices (fig. 59) [Sabah] ..... *O. xustos* Nieser & Chen, 1992

### *Ochterus marginatus* (Latreille)

(fig. 56)

*Acanthia marginata* Latreille, 1804: 242.

*Ochterus marginatus*, Latreille 1807: 143.

*Ochterus marginatus marginatus*, Jaczewski 1934: 602-605 (redescription & synonymy).

[*Ochterus thienemanni* Jaczewski; sensu Nieser & Chen 1992a: 12. Misidentification].

Material. – INDONESIA: Sulawesi Utara, Dumoga

Bone N.P., flußabw. Brücke {downstream of bridge}, 22. X., 10♂ 4♀; Base camp, Stausee {barrage lake}, 22. X., 2♂ 1lvv; Tumpah, Staustufe {weir}, 23.x., 2♂; Tumpah River, ruhige Abschnitt am Moos {quiet part at marsh}, 28. X., 2♂; Sawah (rice-field), 10. XI., 1♂ 2♀. All leg. G. Zimmermann, 1985. Sulur, Dua Saudara N.P. (E. of Manado), 14.iv.1992, 1♀, leg. E. Jäch (NHMW). – Sulawesi Selatan, Samanga, IX.1895, 2♂, leg. H. Frühstorfer (NHMW). – EAST MALAYSIA: Sabah, Sungai Darling, 60 km W Sandakan, 26. XI. 1989, secondary forest, understorey, at light, 3♂ 3♀, M. J. & J. P. Duffels, Sab.43. – PHILIPPINES: Luzon, Quezon prov., Infanta, sandbank at mouth of Agos River, 4. IV. 1993, 4♂ 1♀. Mindanao, Lake Sebu area, Barangay Bakdolong, banks of stream in agricultural area, 3.xii.1993, N9366, 2♂. Both leg. N. Nieser.

Distribution. – A very widespread species, from the Mediterranean and N. part of Africa through India, SE Asia and China to Japan, Taiwan, Philippines, Sulawesi and Jawa.

Remarks. – The first definite record for Sulawesi. However, the two female specimens identified as *O. thienemanni* by Nieser & Chen (1992) from Sulawesi Tenggara turned out to be *O. marginatus*.

### *Ochterus noualhierii* Baehr

(figs. 52, 60)

*Ochterus noualhierii* Baehr, 1990a: 91-93.

Material. – INDONESIA: Sulawesi Utara: Dumoga Bone N.P., Tumpah river, 22. X., 1♂; Lakes I, Quellbereich {source area}, PPA Bungalow, 18. XI., 7♂ 5♀. (NCTN except: 1♂ RMNH, 1♂ 2♀ ZC, 1♂ ZMAN). [The PPA Bungalow is just N of the W tip of Danau Mooat]. Leg. G. Zimmermann 1985. Modinding, NE Kotamobagu, 19.iv.1992, 1♂, leg. M. Jäch (NHMW). Sulawesi Selatan, Umg. {surroundings} Malino, E of Ujung Pandang, 29.iv.1992, 1♂ 1♀ leg. M. Jäch (NHMW). New record for Sulawesi. – Bali, Uluh 'Monkeyforest', 1800m, 21-28.ix.1995, 1♀, leg. Hendrich (NHMW). A male is needed to confirm the identification.

Distribution: Jawa, Sulawesi and ? Bali.

### *Ochterus homorfo* sp. n.

(figs. 54, 61)

Type Material. – Holotype male (NHMW), INDONESIA, Sulawesi Utara, Gunung Ambang NSG, 20 April 1992, leg. M. Jäch. – Paratypes: 47♂ 37♀: same data as holotype 1♂ (NCTN). – Sulawesi Tengah, Lore Lindu N. P., Lindu foot path, 93m, CL2155, 5.x.1985, 28♂ 26♀ (including allotype), leg. J.T. & D.A. Polhemus; Lore Lindu N. P., stream 10 km SE of Kamarora, 950m, CL2156, 8.x.1985, 9♂ 4♀, leg. J.T. & D.A. Polhemus; 19 km SE Palu, 10.x.1985, 9♂ 7♀, leg. J.T. & D.A. Polhemus (all JTPC).

## Description

Dimensions (of holotype mentioned first). Length ♂ 4.2-4.4-4.7, ♀ 4.5-4.7-4.8; width of head ♂ 1.28-1.31-1.40, ♀ 1.28-1.30-1.33; posterior width of pronotum ♂ 2.13-2.29-2.37, ♀ 2.39-2.43-2.50; maximal width (at level of caudal point hemielytral commissure) ♂ 2.30-2.47-2.58, ♀ 2.55-2.67-2.79. Colour, generally dark brown to blackish. Posterior half of pronotum and hemielytra dark brown, head behind ocelli, anterior part of pronotum and scutellum dull black. Head anteriorly of ocelli shining bronze, anterior part of clypeus, labrum and segments 3 and 4 of rostrum yellowish to light castaneous; basal antennal segments dirty yellowish, apicals brownish, eyes castaneous marbled with pale brownish. Lateral margin of pronotum with a yellow spot on explanate part anterolaterally, posteriorly continuing as a narrow line; posterior margin with a narrow, little contrasting medium reddish brown line. Narrow band along costal margin of hemielytra and patch at caudal end of claval commissure yellowish. Legs yellowish, coxae and apices of femurs infuscated. Thoracic venter black except explanate anterolateral area of prothorax yellowish and segmental sutures light brown. Abdominal venter blackish medially, medium brown laterally.

Median carina of head only developed in posterior (upper) half, anterior transverse ridges interrupted to form a shallow V-shaped groove diverging anteriorly. Ridges in median part along anterior half of carina irregular, more laterally roughly parallel converging anteriorly, in posterior part more or less transverse but rather short. Clypeus in profile straight (without transverse depression); rostrum just reaching caudal margin of hind coxae. Anterior width of frons between eyes subequal to slightly narrower than the width of an eye ( $W_{\text{frons}}/W_{\text{eye}}$  0.38/0.42 and 0.41/0.42). Length of antennal segments I:II:III:IV 0.11:0.15:0.30:0.33. Pronotum, posterior width over twice median length (2.13/0.87 and 2.37/1.00); anterior width 1.10-1.15; lateral margins softly but evenly convex, strongly diverging posteriorly; punctures distinct, moderately dense and regularly spaced in posterior half, anteriorly somewhat smaller and less deep in a single row along median line, double row along anterior margin and covering non explanate lateral quarters; posterior margin trisinate. Scutellum, basal width nearly twice the median length (1.21/0.75 and 1.50/0.82). Hemielytra with lateral margins along embolium nearly straight, converging posteriorly; embolium, bases of clavus a double row along each side of claval suture and a field of about  $0.25\text{mm} \approx$  on corium at caudal apex of embolium punctate, remainder smooth; membranes surpassing the apex of abdomen. Male genitalia, pygophore with a broad apex (fig. 54). Shaft of right paramere not noticeably

thickened apically; capitulum of paramere obtusely pointed, appendages highly asymmetrical and comparatively broad (fig. 61).

## Etymology

Homorfos (‘omorphos) Greek adjective meaning beautiful, referring to the dorsal pattern of this species.

## Comparative notes

The apex of paramere especially the broad inner (smaller) appendage differs from all other species in Sulawesi and Philippines (Gapud 1981, 1995, Gapud & San Valentin 1977), except for *O. grandiusculus* which is, however much larger (L 5.3-5.5).

## *Ochterus trichotos* sp.n.

(figs. 55, 62)

Type Material. – Holotype male (NHMW), INDONESIA, Sulawesi Selatan, Malino-Manipi, 700 m, 1 May 1992, leg. Jäch. {The road Malino-Manipi, E of Ujung Pandang crosses the N foothills of G. Lompobatang}. – Paratypes: Sulawesi Selatan, Sungai pattunuang, 13.x.1995, 2♂ 2♀ (including allotype) J.T. & D.A. Polhemus (JTPC)

## Description

Dimensions. Length ♂ 4.5-4.6-4.6, ♀ 4.6-4.8; width of head ♂ 1.22-1.28-1.33, ♀ 1.25-1.25; posterior width of pronotum ♂ 2.33-2.40-2.48, ♀ 2.44-2.44; maximal width (at level of caudal point hemielytral commissure) ♂ 2.44-2.49-2.60, ♀ 2.61-2.77. Colour, generally dark grey to black, hemielytra laterally with a dark grey-brown tinge. Eyes mottled brown and blackish, ocelli castaneous, head anteriorly of ocelli shining black, anterior part of clypeus, labrum and segments 3 and 4 of rostrum yellowish to light castaneous; antennae entirely dirty grey-brown. Lateral margin of pronotum with a yellow spot on anterolateral explanate part, not continuing posteriorly; posterior margin concolorous with disk of pronotum. Costal margin at embolium broadly (0.1 mm), posteriorly more narrowly yellowish. Thoracic venter black except explanate anterolateral area of prosternum, yellowish. Legs dirty yellowish, coxae and apices of femurs infuscated. Abdominal venter dark brown. Dorsal bluish pruinose patches: anterolaterally on pronotum continuing along inner sides of explanate areas; clavus except for a patch in the middle; small proximal and larger halfway and distally on embolium; six irregular patches on corium and irregular anastomosing patches on membrane.

Median carina continuous over total length of head in front of ocelli, at level of anterior half of eyes somewhat less distinct. Laterally at level of anterior half of

eyes a pair of broad shallow grooves. Transverse ridges in anterior half regular, pointing only slightly anteriorly; irregular from midway to posterior quarter and regular but short in posterior quarter. Clypeus in profile straight; rostrum reaching distinctly beyond caudal margin of hind coxae. Anterior width of frons between eyes subequal to the width of an eye ( $W_{\text{frons}}/W_{\text{eye}} 0.40/0.42$ ). Length of antennal segments I:II:III:IV 0.11:0.13:0.30:0.30. Pronotum, scutellum, clavus and corium beset with long (0.10–0.15 mm) erect bristles. Pronotum, humeral width two and a half times its median length (2.48/0.99); anterior width 1.10; lateral margins softly but evenly convex, strongly diverging posteriorly; posterior margin trisinate. Punctures on pronotum and scutellum rather small but distinct, quite densely and regularly spaced, erect hairs originating in the punctures. Scutellum basal width nearly twice the median length (1.21/0.75 and 1.50/0.82), punctures as on posterior half of pronotum. Hemelytra with lateral margins along embolium nearly straight, converging in posterior part. Hemelytral punctures, a double row along inner margin of clavus and a single row along each side of claval suture, evenly dispersed over embolium and corium; membranes surpassing the apex of abdomen. Male genitalia, apex of pygophore fig. 55. Shaft of right paramere not noticeably thickened apically, capitulum somewhat pointed, appendages highly asymmetrical and comparatively broad (fig. 62).

### Etymology

*Trichotos*, Greek adjective meaning hairy, referring to the distinct dorsal pilosity.

### Comparative notes

The right paramere reminds somewhat of *O. polheimi* Gapud from the Philippines (Luzon, Mindoro, Leyte, Mindanao), which has, however, a hooded capitulum and brown hemelytra. *O. trichotos* is distinguished from all Sulawesi and Mindanao species by the hirsute dorsum.

### *Ochterus pardalos* sp. n.

(figs. 53, 63)

Type Material. – Holotype male (NCTN), PHILIPPINES: Mindanao, Lake Sebu area, trickle of water fed by seepage from 'Cold River', 8 Dec. 1993, N9376, leg. N. Nieser. – Paratypes: 1♂ 7♀, Lake Sebu area, at foot of a large waterfall (locally called 'second waterfall') about 30m high causing a lot of fine spray, *Ochterus* on wet rock just outside the spray area, 6.xii.1993, N9368, N. Nieser, 2♀ (one marked allotype, NCTN); Lake Sebu area, Seven Falls, 19.vii.1985, 1♂ 5♀, leg. J.T. & D.A. Polhemus (JTPC).

### Description

Dimensions (the larger ♂ is the holotype). Length ♂ 4.05–4.28, ♀ 4.33–4.55–4.77; width of head ♂ 1.28–1.30, ♀ 1.28–1.28–1.30; posterior width of pronotum ♂ 2.22–2.23, ♀ 2.33–2.37–2.40; maximal width (at level of caudal point hemielytral commissure) ♂ 2.32–2.33, ♀ 2.35–2.43–2.55. Colour, generally dark grey to blackish, hemielytra in females becoming dark brownish distally; abdominal venter castaneous. Head except behind eyes, smooth, shining, between eyes and posterior part of clypeus with metallic bronze tinge, anterior part of clypeus and labrum castaneous, base of rostrum blackish, distally castaneous becoming lighter near tip; basal antennal segments dirty yellowish, apicals brownish, eyes castaneous. Posterior part of head and pronotum dull dark grey, lateral emargin of pronotum with a yellow spot anterolaterally, posteriorly continuing as a narrow line; posterior margin with a narrow, little contrasting medium brown line. Scutellum dark grey with bluish-grey spots. Hemelytra dull, dark grey with numerous bluish-grey spots, embolium with narrow yellowish margin, nodal furrow with an indistinct yellowish spot, hemielytral commissure also with a lighter spot. Legs yellowish, anterior coxae and apices of all femurs brownish.

Frons with a median carina interrupted halfway between eyes, anterior transverse ridges parallel, V-shaped with point anteriorly; posterior ridges irregular. Clypeus in profile straight (without transverse depression); rostrum distinctly surpassing hind coxae. Width of frons between eyes subequal to slightly larger than the width of an eye ( $W_{\text{frons}}/W_{\text{eye}} \text{♂ } 0.48/0.40, \text{♀ } 0.43/0.43$ ). Length of antennal segments I:II:III:IV 0.10:0.13:0.26:0.29. Pronotum, posterior width over twice median length (2.2/0.9); anterior width ♂ 1.15 ♀ 1.20; lateral margins strongly diverging posteriorly; punctures moderately dense, regularly spaced, anteriorly somewhat smaller and less deep; posterior margin trisinate. Scutellum, basal width twice the median length (1.4/0.8), punctures as on pronotum. Hemelytra with lateral margin along embolium nearly straight; embolium, bases of clavus and corium and a row along each side of claval suture punctate, remainder smooth; membranes just surpassing the apex of abdomen. Male genitalia, pygophore with a rather broad apex (fig. 53). Shaft of right paramere not noticeably thickened apically, capitulum rounded, appendages highly asymmetrical (fig. 63).

### Etymology

*Pardalos*, Greek adjective meaning spotted, referring to the strong pattern of bluish-grey pruinose patches on scutellum and hemielytra which are striking in the living animal, especially when it sits in the sunshine.

**Comparative notes**

(see key)

The paramere is very similar to that of *O. noualhierii* (figs. 56, 59) but *O. pardalos* is distinctly darker and larger with body more parallel-sided and lateral margins of pronotum more strongly divergent posteriorly; finally the apex of pygophore is broader (figs. 60, 61). *O. surigaoensis* Gapud (1995) from a similar habitat in the N. of Mindadanao as the 2 ♀ paratypes from second waterfall, is relatively more slender, brownish, has the capitulum of the paramere with a small projection over the base of the appendages and the appendages relatively longer and of different shape.

**Remarks**

Both localities have a slightly cooler microclimate compared to the surrounding area generally. In the more open area of Bakdolong valley *O. marginatus* was collected.

**Family Gelastocoridae** Kirkaldy, 1897

An essentially tropicopolitan family extending into temperate America and Australia, represented in the Old World by the single but large genus *Nerthra* Say, 1832. Rich in species in Central and S. America, Australia and New Guinea (Todd 1961).

Three species have been recorded from Sulawesi: *N. macrothorax* *N. lurida*, and *N. occidua* (Montrouzier 1855, Todd 1959). *N. macrothorax* is a widespread species occurring from Tonga Islands and Australia north to Kyushu and west to the Comores. It is supposed to be distributed (over sea) on floating (plant) debris (Todd 1959, 1960). The other two are only known by their single types.

In the Moluccas there are two species: *N. recta* and *N. toxopeusi* both described by Todd (1959). Likewise only 2 species each have been recorded from Sumatera, Borneo and Philippines so species density seems to be really low in most of the Malesian Archipelago. A few species may still be found as most *Nerthra* species are active during the night and hide in daytime in soft mud or under plant debris and they are only very rarely recorded from light catches, so they are easily overlooked by collectors. Most species live near water bodies but some have been found in or on wet forest floor at places remote from open water.

**Key to Sulawesi species of *Nerthra***

(adapted from Todd 1959)

1. Hemelytra entirely coriaceous and fused together; ocelli absent ..... *N. macrothorax* (Montrouzier, 1855)

- Hemelytra with membrane well developed; ocelli present ..... 2
- 2. Width of head equal to the combined length of pronotum and scutellum; scutellum depressed medially at base ..... *N. occidua* Todd, 1955
- Width of head less than the combined length of pronotum and scutellum; entire scutellum strongly elevated above hemelytra ..... *N. lurida* Todd, 1959

**Family Belostomatidae** Leach, 1815

We have seen only one species of Belostomatidae from Sulawesi: *Diplonychus rusticus* (Fabricius). This species has a very wide distribution and it is quite variable in size and colour. The Sulawesi specimens have been compared with specimens from Sri Lanka, Thailand, Viêt-Nam, SW China, Brunei and Mindanao but no structural differences to split this material up in two or more taxa have been found. A second species: *Lethocerus indicus* (Lepeletier & Serville, 1825) occurs in Sulawesi Utara (Danau Mooat area, J. Polhemus in litt.) but so far we have not personally seen specimens from Sulawesi.

***Diplonychus rusticus*** (Fabricius)*Nepa rustica* Fabricius, 1781: 333*Diplonychus rusticus*, J. Polhemus 1994: 690-692.

Remark. – J. Polhemus (1994) discussed the nomenclatorial problems connected with this name. A proposal to conserve the name for this species was submitted to the ICZN by Polhemus & Kerzhner (1995), and later approved by the ICZN, (1996)

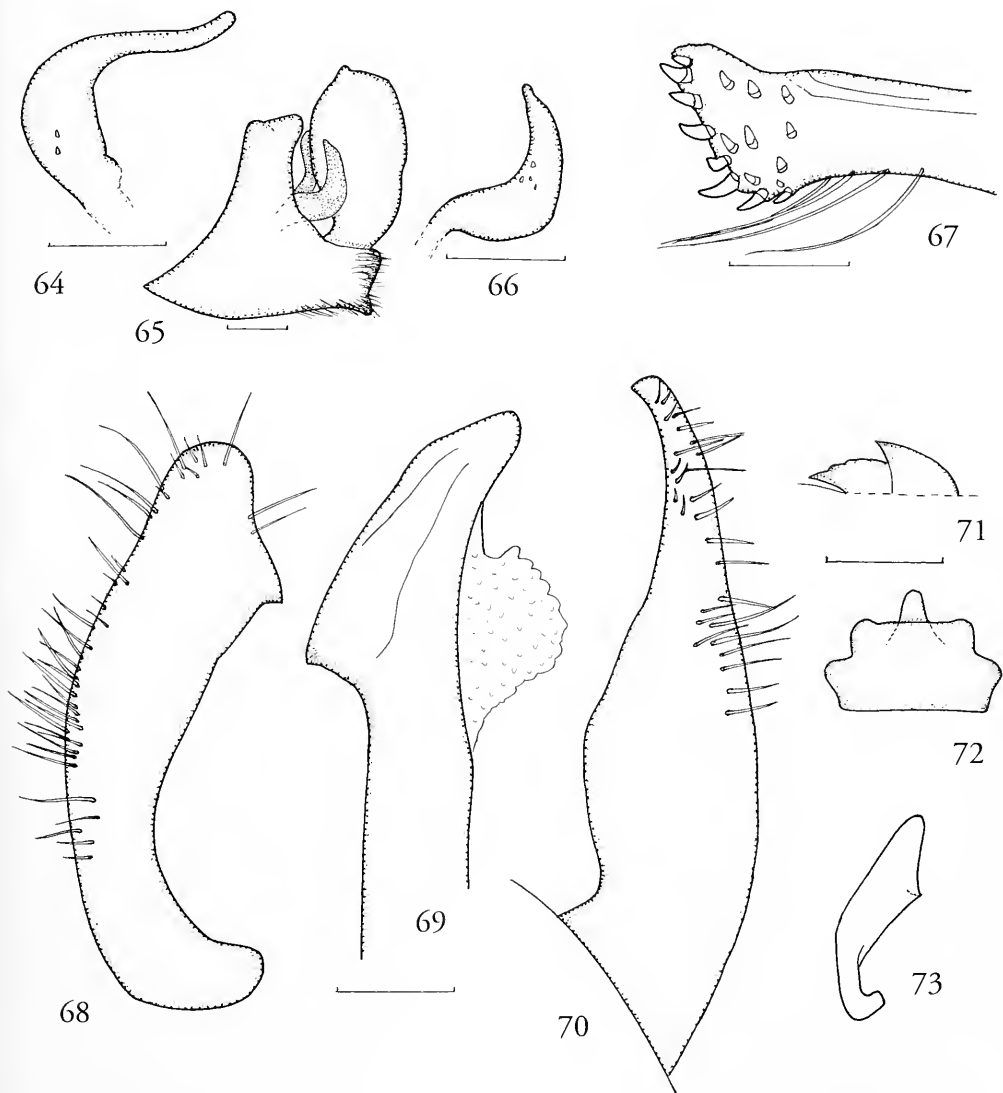
Material. – INDONESIA, Sulawesi Utara: Dumoga Bone N.P. Base Camp, Stauteich {weir-pond}, 17.x.1985, 1♂ 6 larvae; Stau, Teiche {weir, ponds}, 22.x. 2♀; same, 24.x.1985, 1♂ 1♀; Fischteich {Fish pond} 1♂ 4♀; Lichtfang {at light}, 27.x. 1♀; Lichtfang am Tumpah (river), 28.x.1985, 5♂ 17♀; Base Camp, Lichtfang, 4.xi.1985, 2♂ 1♀; sawah, 10.xi. 1♂ 1♀; Lichtfang at laboratory, 24. XI. 1985, 10♂ 15♀. All leg. G. Zimmermann, 1985. – P. Karakelong, Desa Ambela, head of irrigation trench, 30.xi.1994, N9494, leg. N. Nieser, 2♂ 2♀. – Sulawesi Tenggara: Kendari, Wawonggole, pond with abundant vegetation, 20. II. 1989, N8902, 1♂; Aopa marsh, bay at office building, 23. II. 1989, N8913, 1♂ 1♀; Asera, flooded banks of stream, 24. II. 1989, N8918 1♂; Kolaka, pool at edge of marsh 20 km S of Pomalaa, 2. III. 1989, N8927 1♂. – Pulau Buton, Desa Gareng-Gareng, pond without fish, 8. III. 1989, N8938 1♂. All leg. N. Nieser. – BRUNEI DARUSSALAM: Labi road km 291/2, fern and sedge marsh, light brown water, N9342B, 15. IV. 1993, leg. N. Nieser 1♀. – PHILIPPINES, Mindanao: Lake Sebu area, stream at edge of agricultural fields, Bakdolong, at edge, 4. XII. 1993, N9366a, 1♀; Lake Sebu village, pond at market, 7. XII. 1993, N9374a, 4♀ 1lv. all leg. N. Nieser.

Distribution. – Widespread, from India through SE Asia and China to Japan and Sulawesi.

### Family Pleidae Fieber, 1851

A family of small, morphologically very uniform Nepomorpha containing three genera which are mainly differentiated in the numbers of tarsal segments.

Only one genus, *Paraplea* Esaki & China (1928), with two widespread species, is represented in the area of study. An important characteristic used to separate species apart from colour has been the form of the thoracic and abdominal carina. Unfortunately Benzie (1989) has shown in a study of a large population that this characteristic is much more variable within a species than formerly supposed.



Figs. 64-73. Pleidae and Helotrephidae. – 64-67, *Paraplea frontalis*, 64, right paramere (dorsolateral view); 65, genital capsule; 66, left paramere; 67, ovipositor; 68-72, *Hydrotrepes viriosus*, male (68-70), female (71, 72); 68, dorsal paramere; 69, apex of aedeagus; 70, ventral paramere; 71, ventral abdominal carinae II; III; 72, subgenital plate; 73, *Hydrotrepes kamarana*, dorsal paramere; after a sketch by J.T. Polhemus. – Scales 63-70: 0.1 mm, 71, 72: 0.5 mm.

Key to Sulawesi species of *Paraplea*

1. Small species, length 1.3-1.7, pronotum characteristically with three pairs of small round black dots, one pair at humeral angles and one medially near posterior margin, in addition a pair more anteriorly near the median line and a pair more ill-defined medially of the humeral spots may be present. Hemelytra typically with a brown transverse band in the middle, which, however, may be absent in pale specimens, head pattern typically with a median brown stripe only .....  
..... *P. liturata* (Fieber, 1844)
- Larger species, length 2.0-2.4 mm, pronotum lacking the characteristic well-defined dots at humeral angles and posterior margin, hemelytra without distinct transverse band and head pattern usually with one or two pairs small spots dorsally in addition to the median stripe .....  
..... *P. frontalis* (Fieber, 1844)

*Paraplea frontalis* (Fieber)  
(figs. 64-67)*Plea frontalis* Fieber, 1844b: 18, pl. 1 figs. 36-39.*Plea frontalis*, Lundblad 1933: 138-140 (redescription);  
Benzie 1989: 157-171 (redescription).

Material. – INDONESIA, Sulawesi Utara, Pulau Sangir, small roadside pond at last bridge on Sungai Laine from Naha, soft sand bottom, floating plant debris, 17. XI. 1994, N9455a, 4♂ 8♀; Sungai Laine at last bridge from Naha, lowland aspect of small stream, about 8m wide, 0.5m deep, slow current, water with a faint whitish shimmer (probably due to soap from washing cloth), *Hydrilla*, *Ipomoea*, *Lemna*, the latter especially at the edge where the *Paraplea* were caught, 17. XI. 1994, N9456a, 1♂ 3♀; P. Sangihe, Salurang, roadside pond with *Nymphaea*, 20. XI. 1994, N9482, 4♂, 2♀, 3 lrv. Leg. N. Nieser; Sulawesi Utara, Dumoga Bone N.P., Base Camp, Fischteich [fishpond], 19. X. 1985 1♂ 1♀; Base Camp, Stau, Teiche [weir, ponds], 22. X. 1985, 1♀; same 24.x.1985, 1♂; Base camp, Tümpel am Labor [pool at laboratory], 26. X. 1985, 1♀; Base Camp, Lichtfang [at light], 4.xi.1985, 1♀; Sawah, 10.xi. 3♀; Fishpond West of Tungoi, 18.xi.1985, 4♂ 3♀. Leg. G. Zimmermann (ZC). – Sulawesi Tenggara, K. Kendari, Desa Kagunyal, pond covered with *Azolla* and *Lemna*, 100×10m, depth 0.05m, bottom clay and mud, 21. II. 1989, N8906, 1♂ 3♀, 3 lrv; Desa Kagunyal, pond with some *Lemna*, 15×5m, depth 0.05m, bottom clay and mud, 21. II. 1989, N8907, 1♂; K. Kendari, pool on banks of small tributary of Sungai Sampara, 10×3m, depth 0.4m, 22. II. 1989, N8912, 1♂, leg. N. Nieser. – Maluku, Bacan, Wayaua, alt. m ca 50, secondary growth, eutrophic pool, 06-07 July 1985, (RMNH-HH382), 7♂ 14♀ 2lv, leg. J. Huijbregts (RMNH, 2♂ 2♀ NCTN). – Sumatera, Deli, Kuala Simpang, VIII.1953, lowland, cultivated area, 1♀, leg. A. Sol-laert (RMNH). All macropterous and in NCTN unless otherwise specified.

Distribution. – India and Sri Lanka through SE Asia to Taiwan and the Moluccas.

Remarks. – The head pattern figured by both Fieber (1844b) and Lundblad (1933) shows the longitudinal stripe between eyes and a pair of comma-shaped spots at the level of the dorsal margins of eyes in addition a second pair of spots more dorsally on vertex may be present. Already Lundblad (1933) remarks that these four additional spots are usually indistinct or absent. In our material only some specimens from the fishpond west of Tungoi show the comma-shaped spots and the series from Maluku has a rather dark frontal pattern with the most dorsal spots prominent and the comma-shaped ones present but ill-defined. Structurally there is little variation in parameres especially the right one which folds over the genital capsule and is (in latero-dorsal view, fig. 64) longer than usually depicted e.g. Lundblad (1933), in strictly lateral view. The ventral keel varies somewhat and there are differences in average size between populations. Notably the specimens from Sulawesi Tenggara (L 2.05-2.35) are somewhat smaller than those from Sulawesi Utara (L 2.15-2.42) and those from Bacan (L 2.20-2.41). However, we have not been able to find consistent differences between the samples mentioned and some additional specimens from Sumatera and Thailand.

*Paraplea liturata* (Fieber)*Plea liturata* Fieber, 1844b: 19, pl.2 figs. 4-6*Plea liturata*, Lundblad 1933: 129-135, redescription.

Material. – INDONESIA: Sulawesi Utara, Dumoga Bone N.P., Tumpah, at light, 28. X. 1985, 16♂ 24♀; D.B.N.P., Base Camp, Stau, Teiche [weir, ponds], 22. X. 1985, 1♀; same 24.x.1985, 1♂ 5♀; same Lakes, Kleiner See, Fischteich [Smaller Lake, fish pond], 16. XI. 1985, 1♀; Base Camp, Lichtfang [at light], 4.xi.1985, 1♀; all leg. G. Zimmermann. – Sulawesi Tenggara, K. Wawotobi, Wawonggole, Sungai Anggoro, 20. II. 1989, quietly flowing stream in open woodland, depth up to 1m, water dark brown, vegetation hanging from the banks in the water, N8901, 1♀; Sulawesi Tenggara, 20 km S. of Pomalaa, pond at edge of marsh forest, 2. III. 1989, *Nymphaea*, *Juncus*, N8929, 1♀, leg. N. Nieser. – PHILIPPINES: Mindanao, Sarangani prov. Lake Sebu village, village pond next to market, ring-shaped eutrophic pond used e.g. for bathing water buffalo, diameter c 100m, width of moat 5-10m mostly shallow, many Poaceae and Cyperaceae, further water plants of the *Potamogeton gramineus*-group and a *Callitriche* lookalike, 7. XII. 1993, N9374, 2♀, leg. N. Nieser. All macropterous.

Distribution. – India and SE Asia, through Jawa and Sulawesi to New Caledonia.

Remarks. – The small size combined with the typical small black dots on pronotum make this species easily recognizable.

**Family Helotrephidae** Esaki & China 1927

A family of small Nepomorpha which, although united with the Pleidae in the superfamily Pleoidea, is quite diverse morphologically with 16 genera divided over four subfamilies. Greatest diversity is found in continental and insular SE Asia with 10 genera and about 40 species of which *Hydrotrepes* with over 25 species is by far the largest. In our study area five genera are represented (J. Polhemus 1990, Zettel 1994, 1995a, b).

In this section the seventh abdominal sternite of female is referred to as subgenital plate. The length of an eye in Helotrephidae is measured along its longest axis more or less dorso-ventrally, its width is measured in lateral view perpendicular on the hind margin. In Pleioidea the legs have specialised 'spatulate' hairs which, however, do not seem to be useful for species discrimination. The macropterous form has a well-developed claval suture and an additional small antero-ventral (in closed wings) suture. The small antero-ventral area cut off by this suture has been called clavulus (China 1930); it does not seem to have diagnostic value. Brachypters lack these sutures and have the hind wings reduced to small stumps. Zettel (1995a, b) uses the term 'Hinterflügelmikropter' (hind wing mikropter) for these. We use brachypter referring to the condition of the hemielytra (Nieser & Chen 1996). In this family the membranes are reduced in both macropterous and brachypterous forms, they form a callous ridge and a groove which serve as a coupling mechanism to keep the wings closed in rest and has been named pseudomembrane (J. Polhemus 1990).

**Key to Malaysian genera of Helotrephidae**

1. Small species, length up to 1.6 mm ..... 2
- Larger species length over 2 mm, usually over 2.5 mm ..... 4
2. Ventrolateral carina of cephalonotum continuing over the eyes (so the eye is split in a ventral and a dorsal portion) ..... 3
- Ventrolateral carina of cephalonotum not continuing over the eyes [Vietnam, Thailand, W. Malaysia, Sumatera, Sarawak] .....  
..... *Idiotrepes* Lundblad
3. Anterior and intermediate tarsi 2-segmented (first segment very small) [China, Vietnam & N. Borneo] ..... *Distotrepes* J. Polhemus
- All tarsi 3-segmented (first segment very small) [W. Malaysia, Sarawak] .... *Fischerotrepes* Zettel
4. Abdominal sternites 4-6 without median carina [Sri Lanka, Indonesia, Philippines] .....  
..... *Hydrotrepes* China

- Abdominal sternites 4-6 with a median carina [China (incl. Taiwan), Vietnam, Thailand, Malaysia] ..... *Helotrepes* Stål

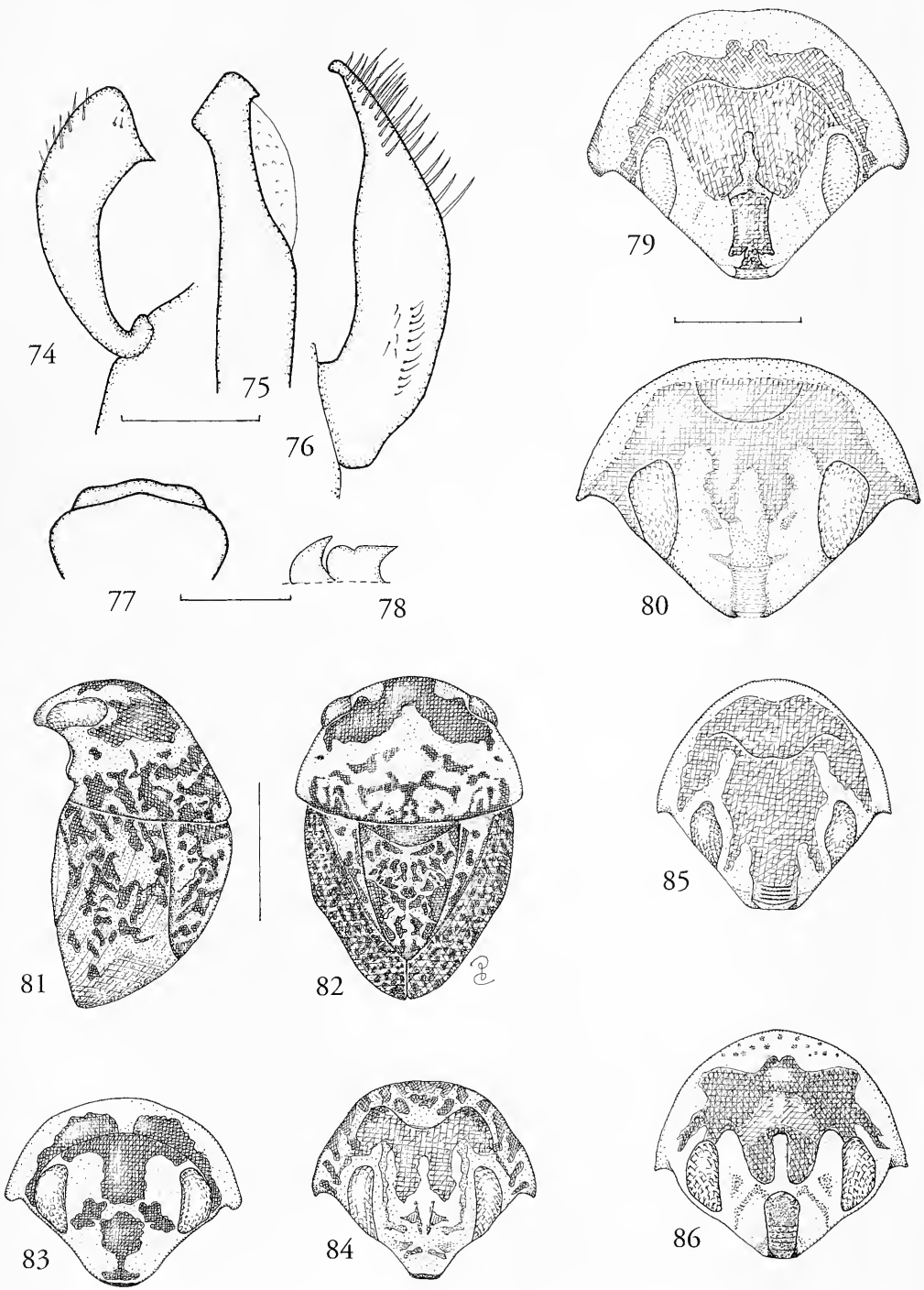
For the three species of *Distotrepes* found in Sabah and Sarawak and the two species of *Fischerotrepes* found in W. Malaysia and Sarawak, the reader is referred to Zettel (1994, 1995b), *Idiotrepes* is in our area represented by an undescribed species from Sarawak (Zettel, 1995b).

Until 1997 six species of *Hydrotrepes* were known, five of them from Indonesia and Philippines, including one, the type species *H. bouvieri* from Sulawesi (J. Polhemus 1990). So it is somewhat surprising that now 11 species are known from Sulawesi alone. Apparently Sulawesi is a special centre of differentiation for this taxon although the occurrence of two new species in a restricted area of Mindanao and a number of undescribed species from various islands reported to be in the JTPC (J. Polhemus 1997) indicates that specific collection might show that there are many more species in the Melanesian area.

J. Polhemus (1997) refrained from presenting a key to Sulawesi species of *Hydrotrepes* as identification is mainly possible by checking the head pattern and male genitalia of specimens to be identified. In order to sort out specimens more quickly we present a key for Sulawesi species here. As there is little doubt that more species are to be found, identification is to be checked by comparing with the complete description of the species in J. Polhemus (1997) and this paper.

**Key to males of *Hydrotrepes* of Sulawesi**

1. Large species, length over 3.25 mm ..... 2
- Smaller, length less than 3.25 mm, usually less than 3 mm ..... 4
2. Dark frontal pattern dorsally between eyes nearly reaching inner margins of eyes; acute projection on inner side of dorsal (smaller) paramere at apical third of paramere (fig. 73); length 2.9-3.4 mm. [Sulawesi Tengah & S. Utara] .....  
..... *H. kamarora* J. Polhemus, 1997
- Dark frontal pattern leaving a relatively broad light stripe along inner margin of eyes; acute projection on inner side of dorsal paramere at apical fourth of paramere (figs. 68, 74); length 3.4-3.8 mm. .... 3.
3. Apex of aedeagus with a small 'head', distance between tip and knob about 0.15 mm (fig. 75); length 3.5-3.8 mm [Sulawesi Tengah]...  
..... *H. mexon* sp. n.
- Apex of aedeagus with larger head, distance between tip and knob 0.3 mm (fig. 69); length 3.4-



- 3.5 mm [Sulawesi Tengah] ..... *H. viriosus* J. Polhemus, 1997
4. Small species, length up to 2.1 mm [Sulawesi Selatan] ..... *H. celebensis* J. Polhemus, 1997
- Larger, length 2.5 mm or more ..... 5
5. Apex of aedeagus with a distinct spur as in fig. 94 ..... 6
- Apex of aedeagus with a knob only, length 2.9–3.4 mm, frontal pattern entirely dark between eyes, a narrower band and a pair of spots under the eyes between eyes and rostrum [Sulawesi Tengah & S. Utara] ..... *H. kamarora* J. Polhemus, 1997
6. Pattern between eyes solid dark brown to black reaching laterally unto margin of eyes and anteriorly halfway eyes or more anteriorly, a narrower band running to labrum may be connected to or separate from dark area between eyes, dorsal paramere truncate (not rounded) apically (fig. 113), length 2.4–3.0 mm [Sulawesi Utara] ..... *H. nieseri* J. Polhemus, 1997
- Pattern between eyes not reaching inner margins of eyes, in case of doubt (*H. taweli* which may be very similar) the dorsal paramere is apically rounded (fig. 114) ..... 7
7. Dorsal paramere with a broad tooth-like projection apically (fig. 98) ..... 8
- Dorsal paramere with inner margin smooth .... 9
8. Dark frontal pattern with irregular lateral margins, continuous from posterior head suture to anteclypeus; apical part of ventral paramere narrow, total length of paramere ten times its width in apical part, length 3.0–3.1 mm ..... *H. marana* J. Polhemus, 1997
- Dark frontal pattern divided in a broader posterior and separate narrower anterior part with more or less straight lateral margins; apical part of ventral paramere more solid, total length of paramere eight times its width in apical part, length 2.5–2.8 mm [Sangir Is.] ..... *H. zetteli* sp.n.
9. Dark frontal pattern divided in partly anastomosing small patches, consequently lateral margins strongly irregular; ventral paramere with narrower apical part relatively short, about one third of total length of paramere (fig. 117), length 2.5–2.6 mm [Sulawesi Selatan] ..... *H. variegatus* J. Polhemus, 1997
- Dark frontal pattern more solid with more or less straight lateral margins; narrower apical part of ventral paramere about half the total length of paramere (fig. 116) ..... 10
10. Frontal pattern between eyes consisting of a pair of oblong patches separated by a light median line, anterior part of dark pattern separated from posterior part, indistinct; dorsal paramere parallel-sided in middle part (fig. 115), length 2.6–2.8 mm [Sulawesi Utara] ..... *H. bouvieri* (Kirkaldy, 1904)
- Frontal pattern between eyes solid and continuous with distinct anterior part; dorsal paramere gradually widening in apical half, length 2.5–2.7 mm [Sulawesi Tengah & S. Utara] ..... *H. taweli* J. Polhemus, 1997

***Hydrotrepes bouvieri* Kirkaldy**

(fig. 115, 126-1)

*Helotrepes bouvieri* Kirkaldy, 1904: 129.*Hydrotrepes bouvieri*; J. Polhemus 1997 45 (redescription).

Material. – INDONESIA: Sulawesi Utara, Gunung Ambang Reserve, PPA bungalow at border of Danau Moat, 1080m asl., 0°44'N 124°27'E, cultivated area, 28/29. V. 1985, leg. J. van Tol, 2♂ 5♀ brach., 2 lv.; Lakes I {also at Danau Moat}, Fischteich {fish pond}, 16. XI. 1985, leg. G. Zimmermann, 1♂ 4♀ brach.

***Hydrotrepes celebensis* J. Polhemus**

(fig. 126-2)

*Hydrotrepes celebensis* J. Polhemus, 1997: 45–47.

Material. – INDONESIA: Sulawesi Selatan, Malino Manipi, 700m, 1. V. 1992 leg. Schödl (31) 1♂; Sulawesi Selatan, Emerasa, N. Banta Eng, 2. V. 1992, leg. Schödl (37), 2♂ brach. (NHMW, 1♂ from Schödl 37 in NCTN).

***Hydrotrepes marana* J. Polhemus**

(fig. 126-2)

*Hydrotrepes marana* J. Polhemus, 1997: 47–49.

Material. – INDONESIA: Sulawesi Selatan, Malino Manipi, 700m, 1. V. 1992 leg. Schödl (31) 1♂ 3♀; Sulawesi Selatan, N. Bulukumba, 2. V. 1992, leg. Schödl (38) 1♂ 1♀. All brachypterous (NHMW except 1♀ from 31 in NCTN).

Figs. 74–86. *Hydrotrepes* spp. – 74–79, *H. mexon*, paratype male (74–76), paratype female (77, 78): 74, dorsal paramere; 75, apex of aedeagus; 76, ventral paramere; 77, operculum; 78, carinae on abdominal sternites II; III; 79, head of holotype male in frontal view; 80, *H. viriosus*, head in frontal view; 81, 82, *H. pardalos*, paratype male habitus, 81, lateral view; 82, dorsal view; 83–86, head in frontal view; 83, *H. pardalos*, paratype male; 84, *H. stereos*, holotype male; 85, *H. polhemii*, paratype female; 86, *H. zetteli*, holotype male. – Scales 74–76: 0.25 mm, 77, 78: 0.5 mm, 79–86: 1 mm.

***Hydrotrepes nieseri* J. Polhemus**  
(fig. 113, 126-2)*Hydrotrepes nieseri* J. Polhemus, 1997: 49-51.

Material. – INDONESIA, Sulawesi Utara, Dumoga Bone N. P.: Dumoga Bone River downstream of bridge, 22. X., 6♂ 14♀ brach., 10♂ 20♀ macr., 8lvV 3lvIV 5lvIII; Base camp, Pfüte am Weg {roadside pools}, 22. X., 1♂ brach.; Tumpah River, tiefer langsam fließender {deeper, slowly flowing ...}, 20. X. 1985, 10♂ 6♀ brach., 1lvV, 2lvIV, 1lvIII; Tumpah, Staustufe {weir}, 23.x., 9♂ 12♀ brach., 3♂ 2♀ macr., 2 lvv 1 lvIV; Tumpah River, 22. X. 2♀ brach.; same, ruhige Abschnitt am Moos {quiet stretch at wet meadows}, 28. X., 1♂ 1♀ brach.; Maze, 7. XI., 1♂ 2♀ brach.; base camp XI.'85 7♂ 3♀ brach., 1♂ 1♀ macr., 2lvV; Kotamobagu, Caves, 26.x. 5♂ 8♀ brach. All leg. G. Zimmermann, 1985 (NCTN & CC). Dumoga Bone N.P., Tumpah, waterfall creek, alt. 230 m., multistr. evergreen forest, creek, 21. V. 1985, J. Huijbregts, RMNH-HH327B 9♂ 10♀ brach., 2♂ 2♀ macr., 1 lviv, 1lvIII; Tumpah river nr confl. Toraut, UTM XL-0063, c. 210 m. asl., 21. V. 1985, leg. J. van Tol 4♂ 4♀ brach., 1♂ macr.; same 25.v.1985 2♂ 2♀ brach.; small creek at edge of primary forest near Base Camp Toraut, c. 0°34'N 123°54'E, 22-24.v.1985, leg. J. van Tol, 1♂ 3♀ brach., 3 lvIII/V (RMNH). Dumoga Bone N.P., Toraut, 21. IV. 1992, leg. Schödl (14), 1♂ 1♀ brach., 2♂ 2♀ macr.; Motoyangan 22. IV. 1992, leg. Schödl (15), 1♂ 1♀ brach., 2♂ 4♀ macr. Dua Saudara N.P., W Batuputih, 15. IV. 1992, leg. Schödl (8), 1♀ brach., 1♂ macr.; Wakan, Amurang-Motoling, 18. IV. 1992, leg. Schödl (10), 2♂ 2♀ brach. (NHMW).

***Hydrotrepes taweli* J. Polhemus**  
(figs. 114, 116, 126-1)*Hydrotrepes taweli* J. Polhemus, 1997: 51-52.

Material. – INDONESIA, Sulawesi Utara, G. Klabat, Sg. Giriam, 23. VI. 1994, N9452, leg. N. Nieser, 3♂ 3♀ brach., 38♂ 35♀ macr. (paratypes), 21 lvV, 3 lvIV; G. Klabat, smaller stream through coconut groove, probably tributary of Sg. Giriam, 23. VI. 1994, N9453, leg. N. Nieser, 2♂ 4♀ brach., 2 lvv, 1 lvIV.

***Hydrotrepes viriosus* J. Polhemus**  
(figs. 68-72, 80, 91, 126-1)*Hydrotrepes viriosus* J. Polhemus, 1997: 53-54.

Material. – INDONESIA: Sulawesi Selatan, Sungai Anowah, 41 km N of Wotu {±20 km S. of Danau Poso} 24 Oct. 1993, narrow streams above water fall in undisturbed rain forest, 650m asl., leg. J. P. & M. J. Duffels (Sul 28), 1♂ brach., 1♀ macr.

**Redescription**

As the original description is based on a single female, we give an additional description based the specimens cited above.

Dimensions, length ♂ 3.38, ♀ 3.5; width across

eyes ♂ 1.80, ♀ 1.88; posterior width of cephalonotum ♂ 2.55, ♀ 2.60; height at base of hemielytra ♂, ♀ 1.60.

Colour, generally dark brown-grey with yellow, eyes dark grey. Holotype male anterior part of cephalonotum predominantly brown-grey, pattern between eyes ill-defined (fig. 80), posterior part yellow, scutellum brownish yellow with ill-defined brown patches, base of hemielytra and pseudomembrane brown-grey; remainder of hemielytra yellow. Allotype female dorsally darker, cephalonotum dark between eyes only with a distinct pattern, in frontal view a broadly bifid dark mark dorsally and a separate rectangular spot at base of rostrum, laterally near eyes lighter, posterior part dark grey with a transverse yellowish band behind middle. Scutellum and basal part of hemielytra dark grey, apical three quarters of hemielytra sordid yellow with ill defined darker mottling. Both specimens with rostrum dark castaneous to blackish, venter medium brown to dark grey, legs pale brownish.

Cephalonotum, scutellum and hemielytra densely beset with alveolar punctures, somewhat less deep and less dense between eyes, clypeus transversely ridged. In dorsal view cephalonotum broader than long (2.6/2.2); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched, prosternal carina with one tip (fig. 91). Eye two times as long as wide (0.66/0.33); minimal width of interoculus slightly less than four times or more the width of an eye (♂ 1.22/0.33 ♀ 1.32/0.30). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.22 and 0.65. Scutellum at base broader than long (1.5/1.1). Ventral carina of pronotum and at base of abdomen well developed (fig. 71).

Male, parameres and aedeagus as in figs. 68-70.

Female, subgenital plate (abdominal sternite 7) with a median process caudally (fig. 72).

Macropterous form essentially as apterous except for the development of hind wings and claval suture and clavulus on hemielytra.

**Comparative notes**

The left paramere is similar to that of *H. celebensis* and *H. marana*, supporting the supposition of J. Polhemus (1997) that *H. celebensis* seems to be the closest congener. However, *H. celebensis* is distinctly smaller, length 2.40-2.42, its female subgenital plate has an indication of mediocaudal process (not reaching beyond the apices of the lateral angles) only, the dorsal paramere is more slender, the apical part of the ventral paramere somewhat stouter and the the heel of the apex of aedeagus more rounded; *H. marana* is also smaller, length up to 3.1 mm, width up to 2.16 mm and its aedeagus has a well developed spur. Although the

macropterous female holotype of *H. viriosus* is smaller (L 3.09) and broader (W cephalonotum 2.82) the head pattern, female subgenital plate, ventral abdominal carinae II, III and various ratios agree sufficiently to consider these as belonging to the same species.

***Hydrotrepes mexon* sp. n.**

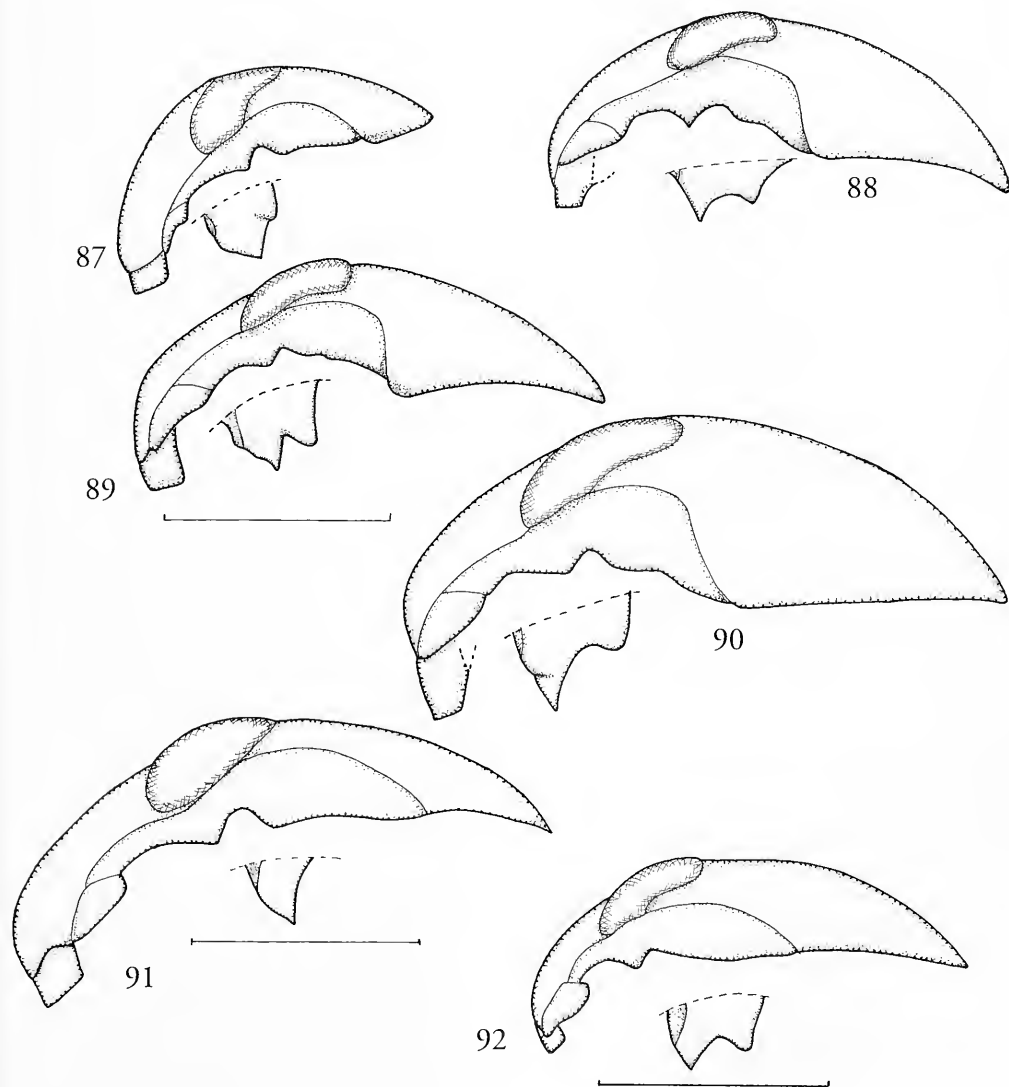
(figs. 74-79, 90, 126-2)

Type Material. – Holotype brachypterous male

(NHMW, genital capsule detached, glued to the same card as the specimen): INDONESIA: Sulawesi Tengah, Salopo near Poso See, 29 Jan. 1995, leg. Seyfert & Greindl (45). – Paratypes (adults only) 2♂ 2♀ (including allotype) brach., 1♂ macr., 1 lvV (NHMW except 1♂ brach. NCTN).

**Description**

Brachypterous form. – Dimensions length ♂ 3.50-3.63-3.80, ♀ 3.70-3.80-3.89; width across eyes ♂



Figs. 87-92. *Hydrotrepes* spp.: cephalonotum and prosternal carina in lateral view. – 87, *H. pardalos*, paratype male; 88, *H. polhemi*, paratype male; 89, *H. stereos*, paratype female; 90, *H. mexon*, paratype male; 91, *H. viriosus*, female; 92, *H. zetteli*, paratype female. – Scales 1 mm.

1.86-1.88-1.90, ♀ 1.98-1.99-2.00; posterior width of cephalonotum ♂ 2.59-2.60-2.60, ♀ 2.69-2.69-2.70; height at base of hemielytra ♂ 1.32-1.36-1.39, ♀ 1.40-1.51-1.63. Dimensions of single macropterous ♂ length 3.61, width across eyes 1.94, posterior width of cephalonotum 2.69, height 1.32.

Colour, generally yellowish with brown-grey to blackish markings, eyes blackish. Frons with blackish markings which become gradually narrower toward rostrum (fig. 79). Cephalonotum behind eyes blackish, posterior part yellowish with sparse dark mottling. Scutellum and hemielytra predominantly dark by dense confluent dark patches. Venter brown to dark grey, genal, pronotal pro- and meso- pleural plates and legs except at base, pale.

Cephalonotum, scutellum and hemielytra densely beset with impressed punctures, somewhat less deep and less dense between eyes, anteclypeus transversely ridged most distinctly in macropterous males. In dorsal view cephalonotum broader than long (2.6/2.2); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched, prosternal carina bifid (fig. 90). Eye 2.5 times as long as wide (0.76/0.31); minimal width of interoculus four times or more the width of an eye (♂ 1.22/0.31 ♀ 1.32/0.30). First two segments of rostrum very short, length of segments 3 and 4, 0.28 and 0.66 respectively. Scutellum at base broader than long (1.6/1.2). Ventral carina of pronotum and at base of abdomen well developed (fig. 78).

Male, parameres and aedeagus as in figs. 74-76.

Female, subgenital plate (abdominal sternite 7), caudally truncate (fig. 77).

Macropterous form – Essentially as apterous except for being relatively broader and development of hind wings and claval suture and a small subtriangular area sutured off ventrobasally on hemielytra. Eye twice as long as wide (0.75/0.38).

### Etymology

Mexon, comparative of Greek adjective meaning larger referring to the size of this species which is longer than its Sulawesi congeners.

### Comparative notes

Apart from the distinctive male genitalia, this species is about 0.5 mm longer and has a more strongly developed prosternal carina than any known Sulawesi species.

### *Hydrotrepes polhemi* sp. n.

(figs. 85, 88, 93-97, 126-2)

[*Hydrotrepes angulatus* China: sensu Nieser & Chen 1992b: 33. Misidentification].

Type Material. – Holotype brachypterous male

(MUDH) INDONESIA: Nusa Tenggara Timor prov., Flores, 9 Km S of Maumere, sea level, 18. April 1986, cultivated area, in slow flowing brook, leg. A. L. van Berge Henegouwen & S. Pariwono. – Paratypes: 7♂ 24♀, same data as holotype: 1♂ 4♀ (including allotype) brach., 2♂ 1♀ macr. (MUDH except for 1♂ 1♀ brach. NCTN); Flores, Wae Garit River, 6 km W of Ruteng, CL2179, 24.x.1985, 1100m, 5♂ 19♀ brach., 1♂ macr., 6lvV, J.T. & D.A. Polhemus (JTPC).

### Description

Brachypterous form. – Dimensions length ♂ 2.82-2.87-3.00, ♀ 2.77-2.92-3.14; width across eyes ♂ 1.38-1.40-1.44, ♀ 1.39-1.44-1.50; posterior width of cephalonotum ♂ 1.89-1.93-2.00, ♀ 1.83-2.00-2.11; height at base of hemielytra ♂ 1.29-1.30-1.31, ♀ 1.30-1.33-1.41.

Colour, generally yellowish to light brown. cephalonotum posteriorly yellow with light brown mottling, eyes grey-blackish. In frontal view a solid brown patch between eyes narrowing anteriorly and leaving a yellow band at inner margins of eyes (fig. 85). Scutellum and hemielytra light brown with variable, irregular and little contrasting medium brown mottling.

Cephalonotum, scutellum and hemielytra densely beset with impressed punctures, somewhat less deep between eyes and somewhat less dense on scutellum. Anteclypeus transversely ridged. In dorsal view cephalonotum broader than long (2.0/1.2); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched (fig. 88). Eye twice as long as wide (0.52/0.25); minimal width of interoculus about four times the width of an eye (♂ 0.93/0.24 ♀ 0.97/0.27). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.20 and 0.48. Scutellum at base as broad as or slightly broader than long (1.20/1.15). Prosternal carina with two tips (fig. 88), carina at base of abdomen well developed (fig. 97).

Male, parameres and apex of aedeagus as in figs. 93-95.

Female, subgenital plate, caudally with a median tongue-like extension (fig. 96).

Macropterous form. – As brachypterous form except for development of hemielytra and hind wings and being somewhat broader relatively. In addition the carina over the lateral margin of cephalothorax does not quite reach its latero-caudal tip, forming a small angle. Dimensions of macropterous males and single female; length ♂ 2.72-2.75-2.78, ♀ 2.79; width across eyes ♂ 1.36-1.38-1.40, ♀ 1.40; posterior width of cephalonotum ♂ 1.89-1.95-2.02, ♀ 2.01; height ♂ 1.31-1.37-1.42, ♀ 1.30.

### Etymology

Polhemi, genitive of Polhemus, named in honour of Dr. John T. Polhemus whose earlier survey of Sulawesi *Hydrotrepes* facilitated our work on this genus considerably.

### Comparative notes

Similar to several Sulawesi species: *H. kamarora*, *H. nieseri* and *H. taweli* all described by J. Polhemus (1997) which are of about the same size, have a similar frontal pattern and have the subgenital plate of female with a more or less distinct caudal tongue. They all have a different paramere, the aedeagus of *H. kamarora* has a reduced apical spur, *H. nieseri* and *H. taweli* have the prosternal carina with one tip only. The latero-caudal angle of the cephalonotal carina is much smaller than the angulated tooth in *H. angulatus* China which has moreover a more irregular frontal pattern and a truncate subgenital plate in female.

*Hydrotrepes zetteli* sp. n.  
(figs. 86, 92, 98-102, 126-2)

Type Material. – Holotype, brachypterous male (NCTN), INDONESIA, Sulawesi Utara, Sangir Island, Sungai Laine at 'tourist spot', Desa Laine (sometimes also spelt Leing). Small stream with waterfalls, inhabited area, *Hydrotrepes* from shaded part of large pothole at foot of waterfall, 12 Nov. 1994 leg. N. Nieser. – Paratypes same data as holotype 2♀ brach. (including allotype), 1♀ macr. (NCTN, 1♀ brach NHMW).

### Description

Dimensions length ♂ 2.70, ♀ 2.53-2.66-2.80; width across eyes ♂ 1.37, ♀ 1.35-1.38-1.40; posterior width of cephalonotum ♂ 1.85, ♀ 1.83-1.86-1.90; height at base of hemielytra ♂ 1.50, ♀ 1.40-1.43-1.45.

Colour, generally dirty yellow with medium to dark brown markings. Cephalonotum with a transverse brown band behind eyes, with a medio-anterior projection slightly over half as wide as interoculus, medially cut by a yellowish line, anterior part of head with a narrower brown stripe (fig. 86). Posterior part of cephalonotum light with darker patches, notably a row along posterior margin. Hemielytra densely mottled with brown, scutellum lighter. Venter brown to dark grey, legs except at base, genal, pronotal and mesopleural plates pale, rostrum castaneous.

Cephalonotum, scutellum and hemielytra densely beset with impressed punctures, somewhat coarser on hemielytra and scutellum. Anteclypeus transversely ridged. In dorsal view cephalonotum broader than

long (1.9/1.4); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched, prosternal carina bifid (fig. 92). Eye 1.7 times as long as wide (0.50/0.29); minimal width of interoculus about three times the width of an eye (0.90/0.29). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.20 and 0.50. Scutellum at base as broad as or broader than long (1.17/1.05). Prosternal carina with two tips (fig. 97), carina at base of abdomen well developed (fig. 102).

Male, parameres and apex of aedeagus as in figs. 98-100

Female, subgenital plate, caudally with a median tongue-like extension (fig. 101).

Macropterous form as brachypterous form except for development of hemielytra and hind wings and being relatively somewhat broader. Dimensions of single macropterous ♀: length 2.71, width across eyes 1.40, posterior width of cephalonotum 1.93, height 1.50.

### Etymology

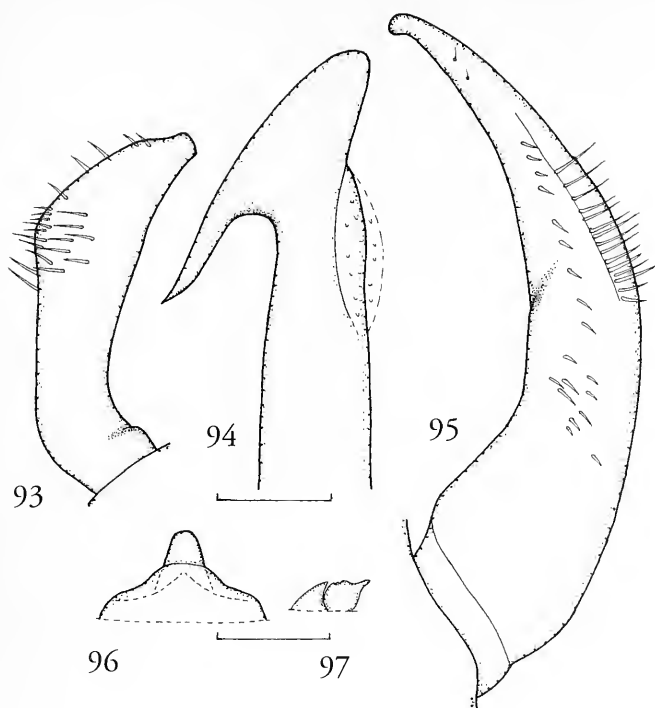
Zetteli, genitive of Zettel, named in honour of Dr. Herbert Zettel for his work on SE Asian water bugs.

### Comparative notes

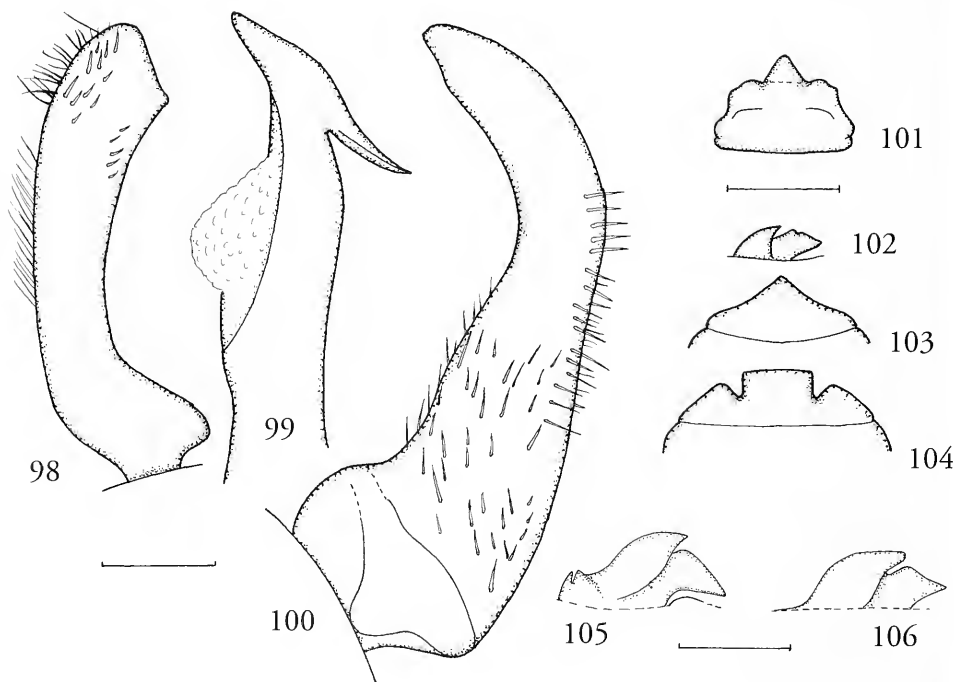
At first sight very similar to *H. pardalos* sp. n. from Mindanao. Apart from differences in details of head pattern, the male genitalia (figs. 98-100, 107-109) and subgenital plates of females (figs. 101, 103) show distinct differences. For differences with similar Sulawesi species see key.

*Hydrotrepes pardalos* sp. n.  
(figs. 83, 92, 105, 107-109)

Type Material. – Holotype brachypterous male (NCTN): PHILIPPINES: Mindanao, Lake Sebu area, Bakdolong, at base of hills, small mountain stream in cultivated area, banks mostly with trees shading most of the stream, strong current alternating with pools and quiet bays mainly under narrowly overhanging banks (*Hydrotrepes*), 10 Dec. 1993, N9379, leg. N. Nieser. – Paratypes (adults only): 80♂ 59♀: Mindanao: Same data as holotype 22♂ 14♀ brach., 2♂ 3♀ macr., 4 lvV. (NCTN except 3♂ 3♀ JTPC, 3♂ 3♀ NHMW, 1♂ 1♀ ZMAN, all brachypters). W. side of Sarangani Bay, Siguel River in deforested area, side pools of stream with low slightly overhanging grass banks, stagnant, water slightly turbid, area about 20 m<sup>2</sup>, depth up to 0.2 m, 23. XI., N9351, 5♂ 3♀ brach., 1♀ macr., 3 lvV; Right side of Sarangani bay, Glan River, at edge. against tree trunk, no current, 26. XI., N9357, 1♀ macr., 1lvV, 1lvIII. Lake Sebu area, Bakdolong,



Figs. 93-106. *Hydrotrepes* spp., details. – 93-97, *H. polheimi*, paratype male (93-95), paratype female (96; 97): 93, dorsal paramere; 94, apex of aedeagus; 95, ventral paramere; 96, subgenital plate; 97, carinae on abdominal sternites II; III; – 98-102, *H. zetteli*, holotype male (98-100), paratype female (101; 102): 98, dorsal paramere; 99, apex of aedeagus; 100, ventral paramere; 101, subgenital plate; 102, carinae on abdominal sternites II; III; 103, *H. pardalos*, paratype female, subgenital plate; 104 *H. stereos*, ditto; 105, *H. pardalos* paratype female, carinae of abdominal sternites II; III; 106 *H. stereos*, paratype female, ditto. – Scales 93-95, 98-100: 0.1 mm, 96, 97, 101-106: 0.5 mm.



stream through agricultural area adjacent to lake (same stream as N9379): mouth of stream, lowland stream aspect, low but steep banks, grassland and rice fields, at edge, 3. XIII., N9364, 2♀ brach.; canalized mountain stream, 3.xii., N9366 1♂ (RMNH); same, 4. XII., N9366a, 6♂ 1♀ brach. (1♂ 1♀ MUDH), 1♀ macr. (RMNH) Lake Sebu area: Just upstream of 3rd waterfall, edge upstream of boulder, between some floating plant debris, surroundings, one side with remnant of primary forest, C: 270µS, 7. XII., N9371, 7♂ brach.; Just downstream of dam at Lopo, edge of stream between grass from banks, 9. XII., N9377B, 2♀ brach.; Irrigation canal downstream of dam at Lopo, fast current, between plants at edge, 9. XII., N9378, 1♂ brach. All leg. N. Nieser 1993 and in NCTN unless otherwise indicated. Mindanao, Bukidnon prov., Malaybalay, Springsite, 650m, 7.xi.1966, 12♂ 17♀ 6lvV, (NHMW, UPLB); Malay Balay, Kaamulan site, 650m, 15-16.iii.1997, 6♂ 3♀ brach.; Misamis occ. prov, W. Ozamiz, Tangub, Lumban, 6.iii.1997, 5♂ 1♀ brach. (UPLB, ZCWA); all leg. H. Zettel. Mindanao, Sarangani prov., Luhib River, 13 km SW of Surallah, 600m, 19.vii.1985, 3♂ 2♀ brach., J.T. & D.A. Polhemus; Sarangani prov., Caboc River, SE of Koronadal, 550, 20.vii.1985, 10♂ 10♀, 8lvV, leg. J.T. & D.A. Polhemus (JTPC).

## Description

Brachypterous form. – Dimensions length ♂ 2.23-2.32-2.43, ♀ 2.40-2.47-2.51; width across eyes ♂ 1.20-1.22-1.26, ♀ 1.23-1.29-1.30; posterior width of cephalonotum ♂ 1.62-1.67-1.70, ♀ 1.72-1.76-1.80; height at base of hemielytra ♂ 1.00-1.07-1.15, ♀ 1.05-1.24-1.50.

Colour, dorsally pale yellow with variable dark brown-grey markings. Eyes dark castaneous to blackish. Head region (fig. 83), typically with a broad median band between upper half of eyes, anteriorly a pair of small dots and a larger median dot, the pattern of these patches is, however, quite variable. Pronotal area anteriorly with a solid transverse dark area posteriorly with variable mottling which tends to be confluent in dark specimens. Scutellum and hemielytra variably mottled with dark, scutellum usually lighter than hemielytra.

Cephalonotum densely punctate to finely alveolate, postclypeus transversely ridged. In dorsal view cephalonotum broader than long (1.75/1.30); lateral margin carinate over its entire length. Pro- and mesopleural plates widely but relatively shallowly notched (fig. 92). Eye longer than wide (0.47/0.28), minimal width of interoculus over 2 1/2 times the width of an eye (0.80/0.28). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.20 and 0.35. Scutellum only slightly longer than its basal

width (0.95/0.93). Ventral carina at base of abdomen well developed (fig. 92).

Male, parameres and aedeagus as in figs. 107-109.

Female, subgenital plate, triangular (fig. 103).

Macropterous form. – Essentially as apterous except for being relatively broader and development of hind wings and claval suture on hemielytra. Dimensions: length ♂ 2.30-2.35-2.40, ♀ 2.40-2.42-2.45; humeral width of cephalonotum ♂ 1.65-1.72-1.78, ♀ 1.72-1.77-1.80.

## Etymology

Pardalos, Greek adjective meaning variegated or spotted, referring to the variable but nearly always strong mottling on dorsal and lateral surfaces of this species.

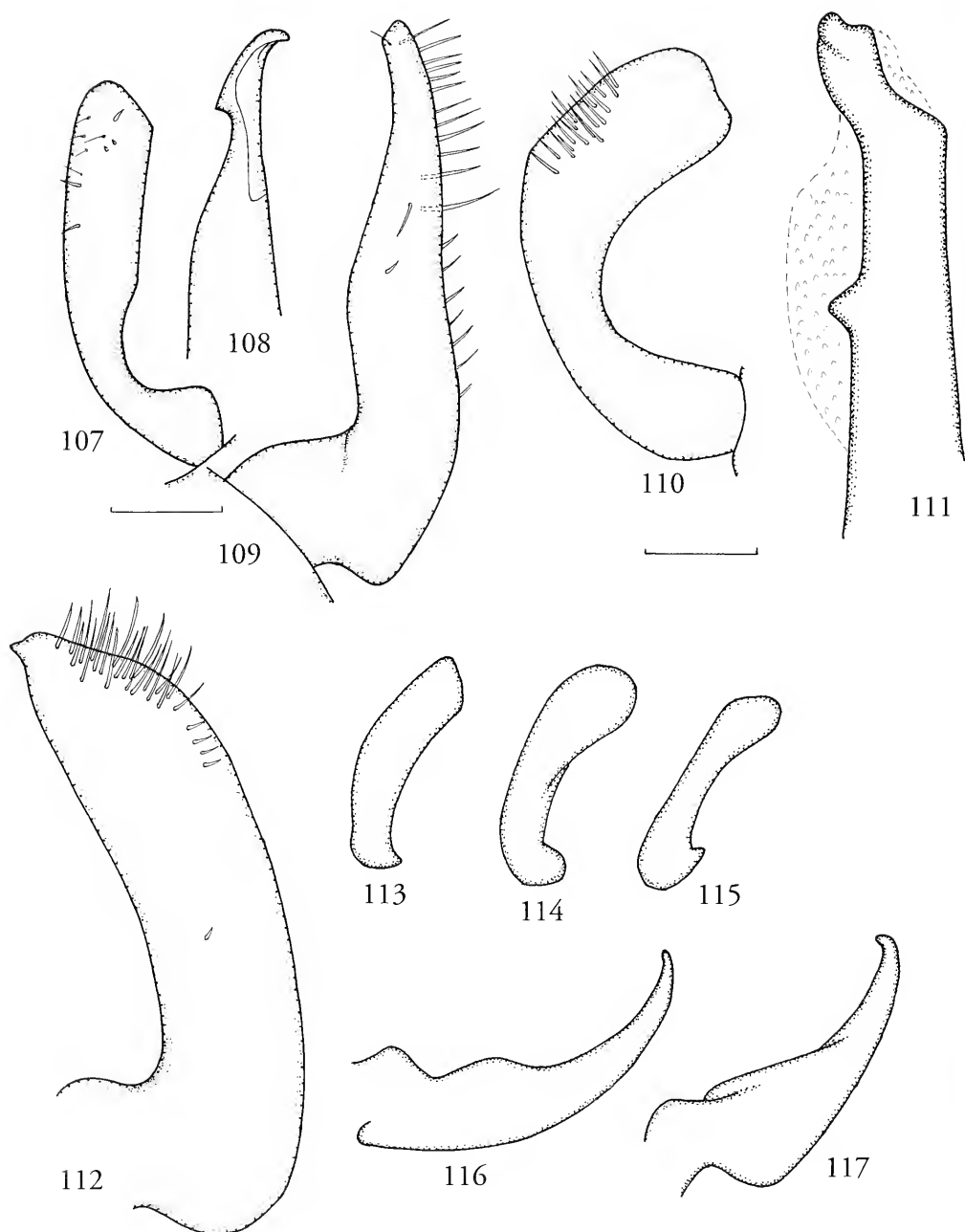
## Comparative notes

About the same size as the other known species from the Philippines (Luzon), *H. balnearius* (Bergroth) which has, however, a rather uniformly dark coloured head. Species from N. Sulawesi have different male genitalia, specifically the apex of aedeagus usually has a strongly developed spur pointing backward (J. Polhemus 1997). For *H. stereos* see below.

## *Hydrotrepes stereos* sp. n.

(figs. 84, 94, 104, 106, 110-112)

Type Material. – Holotype macropterous male (NCTN): PHILIPPINES, Mindanao, Lake Sebu area, 'Cold River' one of the streams feeding Sebu lake, mountain stream, clear hyaline water, many cascades alternated with short ± level stretches with pebbly bottom, C:210µS, surroundings valley and flat parts cleared, slopes mostly with secondary forest, but also with a few pockets of primary forest, 8 Dec. 1993, N9375. 76♂ 106♀ paratypes (adults only): Mindanao, Lake Sebu area: Same data as holotype, allotype brach. ♀ and 1♂ macr., 1lvIV 1lvV; second (largest) waterfall in stream out of lake, at foot of ± 30m high waterfall, large pothole, a lot of fine spray, sample at quiet edge, 6. XII., N9368 1♀ brach. (ZMAN); Just upstream of 3rd waterfall, edge upstream of boulder, between some floating plant debris, surroundings, one side with remnant of primary forest, C: 270µS, 7. XII., N9371, 7♀ brach. (1♀ NHMW); Just downstream of dam at Lopo, edge of stream between grass from banks, 9. XII., N9377B, 1♂ 2♀ brach. (1♂ 1♀ JTPC, 1♀ RMNH); Further downstream of dam at Lopo, agricultural fields, open but shaded by stand of bamboo at the upstream point of small island, 9. XII., N9377C, 1♀ brach. all leg. N. Nieser 1993 and in NCTN unless otherwise specified). Mindanao Bukidnon prov., 8 km NW Lanta-



Figs. 107-117. *Hydrotrepes* spp., details. – 107-109, *H. pardalos*, paratype male; 107, dorsal paramere; 108, apex of aedeagus; 109, ventral paramere; 110-112, *H. stereos*, holotype male; 110, dorsal paramere; 111, apex of aedeagus in ventral view; 112, ventral paramere. – 113-117, outline of parameres: 113-115 dorsal, 116; 117 ventral: 113, *H. nieseri*; 114, *H. taweli*; 115, *H. bouvieri*; 116, *H. taweli*; 117, *H. variegatus* (after Polhemus 1997). – Scales 107-112: 0.1mm, 113-117: not on scale.

pan Sonka, Analib River, 950m, 8.xi.1996, 2♂ 2♀ brach.; 4 km N Lantapan Kaatuan, Kalusikan River, 850m, 9.xi.1996, 46♂ 63♀ brach., 5♂ 4♀ macr., 22lvV (7♂ 7♀ brach. NCTN); 18 km W Lantapan Pasah, Tugasan River, 850m, 10.xi.1996, 13♂ 16♀ brach., 1♂ 2♀ macr., 7lvV; leg. H. Zettel (NHMW, UPPC). Mindanao, Sarangani prov., Luhib River, 13 km SW of Surallah, 600m, 19.vii.1985, J.T. & D.A. Polhemus, 6♂ 6♀ brach.; Tudaya, 26.vii.1970, 1♂ 1♀ brach., leg. M. Satô (JTPC).

## Description

Dimensions, males macropterous form, females brachypterous form. Length ♂ 2.80-2.86-2.94, ♀ 2.90-3.02-3.12; posterior width of cephalonotum ♂ 1.95-1.99-2.07, ♀ 2.08-2.15-2.23; width across eyes ♂ 1.40-1.44-1.46, ♀ 1.54-1.59-1.62; height at base of hemielytra ♂ 1.2-1.3, ♀ 1.1-1.2. Dimensions of single brachypterous male: length 2.99, posterior width of cephalonotum 2.02, width across eyes 1.50.

Colour. Dorsally generally brownish yellow with dark brown-grey markings, eyes blackish. Dark stripe dorsally between eyes, reaching slightly more than halfway, usually divided by a narrow light band medially (fig. 84). Postclypeus rarely with a faint dark mark. cephalonotum posteriorly of eyes usually with confluent dark spots except for a light patch medioanteriorly on pronotal area. Hemielytra and scutellum with fine dense dark grey points which may become confluent to form larger patches especially at base of hemielytra. Venter light brown with ill-defined infuscations. Legs yellowish with some small dark stripes and spots.

Cephalonotum, scutellum and hemielytra densely punctate, postclypeus transversely ridged most distinctly in macropterous males. In dorsal view cephalonotum broader than long (2.0/1.4); lateral margin carinate over its entire length. Pro- and mesopleural plates widely but relatively shallowly notched (fig. 94). Eye twice as long as wide (0.58/0.30); minimal width of interoculus slightly over three times the width of an eye (♂ 0.90/0.28 ♀ 1.07/0.30). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.22 and 0.44. Scutellum at base broader than long (1.17/1.00). Ventral carina at base of abdomen well developed (fig. 106).

Male, parameres and aedeagus as in figs. 110-112.

Female, subgenital plate, strongly incised (fig. 104).

Macropterous form. – Essentially as apterous except for being relatively broader and development of hind wings and claval suture and a small subtriangular area sutured off ventrobasally on hemielytra.

## Etymology

Stereos, Greek adjective meaning robust, referring to the solid build of this species.

## Comparative notes

Similar to *H. pardalos* except for larger size. Typically marked specimens have a narrow median light stripe in the dark band between eyes which does not occur in *H. pardalos*, compare figs. 83, 84. The aedeagus and subgenital plate of female are different (figs. 103, 104, 107-112).

## *Helotrephes otoeis* sp. n.

(figs. 118-124)

Type Material. – Holotype brachypterous male and allotype brachypterous female (RMNH), EAST MALAYSIA, Sabah, 60 km W of Lahad Daru, DVFC, Sg. {stream} Palum Tambun, near bridge, 117.48E 4.58N, 150m, 14 Mar. 1987, leg. J. Huisman. – Paratypes: 7♂ 9♀: Sabah, Danum Valley, Palum Tambun, 2-13.ii.1997, about 10 m wide stream with variable current, near mouth with Segama River, 2♂ 5♀; Sapat Kalisan, 12.ii.1997, stream 4-6m wide, rather shallow but with some deeper parts also nearly stagnant stretches, 3♂ 2♀, all brach., leg. H. Zettel (NHMW, UMSK, NPSC); Sabah, Danum Valley, Palum Tambun, 7-12.ii.1997, 2♂ 1♀, brach., leg. H. Zettel & al. (NHMW, UMSK). Sabah, Kuamat River, near kampung Pisang Pisang, 3/4.vii.1996, shaded stream in primary forest with submerged wood, 1♀ brach., collector unknown (NHMW).

## Description

Dimensions, length ♂ 2.32-2.34-2.38, ♀ 2.32-2.40-2.47, posterior width of cephalonotum ♂ 1.80-1.84-1.90 ♀ 1.82-1.90-1.96, width across eyes ♂ 1.28-1.33-1.39 ♀ 1.30-1.35-1.39, height at base of hemielytra ♂ 1.2-1.3-1.4 ♀ 1.30-1.5-1.6.

Colour, yellowish mottled with medium brown, eyes castaneous, venter dark. Mottling on cephalonotum irregular but leaving a more or less well-defined median longitudinal pale stripe free. Central part of prothoracic part of cephalonotum with four distinct larger brown spots arranged in a trapezium, narrower posteriorly (fig. 120). Posterior border of cephalonotum with a row of distinct larger brown spots. Scutellum with four larger spots along its margin, one pair about halfway, one pair near apex. Hemielytra more densely mottled and appearing darker, with an irregular row of large spots along costal margin (fig. 118).

Cephalonotum, scutellum and hemielytra rugulose due to a dense pattern of alveoli, postclypeus transversely ridged. Humeral angle of cephalothorax with a process (figs. 118-120). In dorsal view cephalonotum broader than long (1.85/1.37); lateral margin carinate over its entire length. Pro- and mesopleural plates widely but relatively shallowly notched (fig. 125). Eye twice as long as wide (0.53/0.27); minimal

width of interoculus three times the width of an eye or less ( $\sigma$  0.75/0.25  $\varphi$  0.80/0.30). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.18 and 0.35. Scutellum at base broader than long ( $\sigma$  0.90/0.80  $\varphi$  0.93/0.90). Ventral carina as in fig. 123.

Male, parameres as in figs. 121, 122.

Female, subgenital plate, laterally indented (fig. 124).

### Etymology

Otoeis, greek adjective meaning 'with an ear or handle', referring to the (in frontal view) earlike extensions at humeral angles of pronotum.

### Comparative notes

This species is immediately recognized by the process at the humeral angles of pronotum (figs. 118-120). Within described species it is in view of the structure of the male genitalia, closest to *H. semiglobosus* Stål.

### Remarks

There were four described species of *Helotrephes* known (J. Polhemus 1990, Zettel 1995a) but there are some seven or eight new species from Thailand

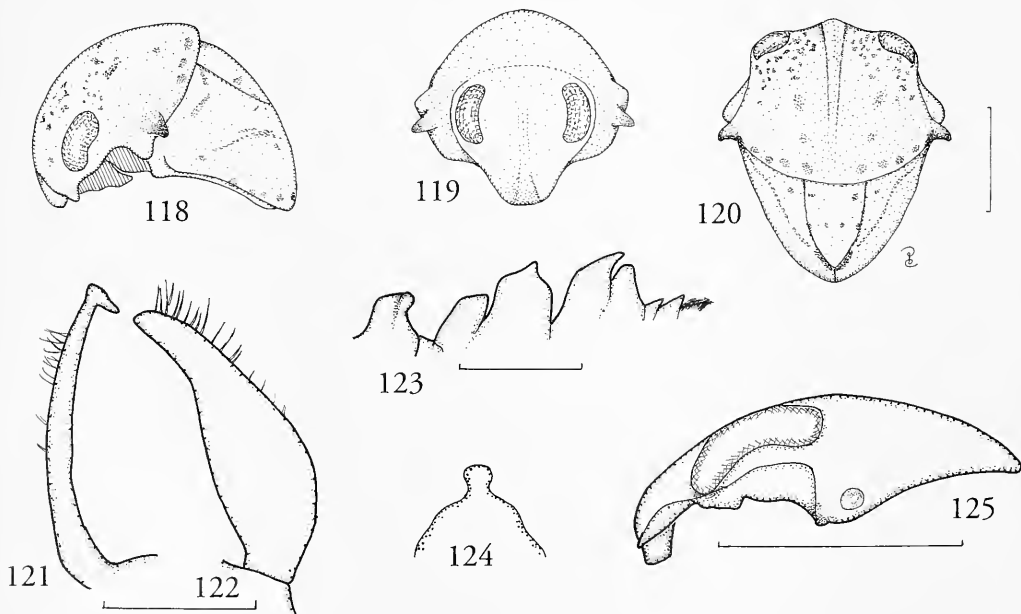
awaiting description (Zettel 1996). *H. otoeis* is the first representative of the genus found in the Malesian Archipelago at some distance from the continent. The only other island species, *H. formosanus* is known from Taiwan.

### Family Notonectidae Latreille, 1802

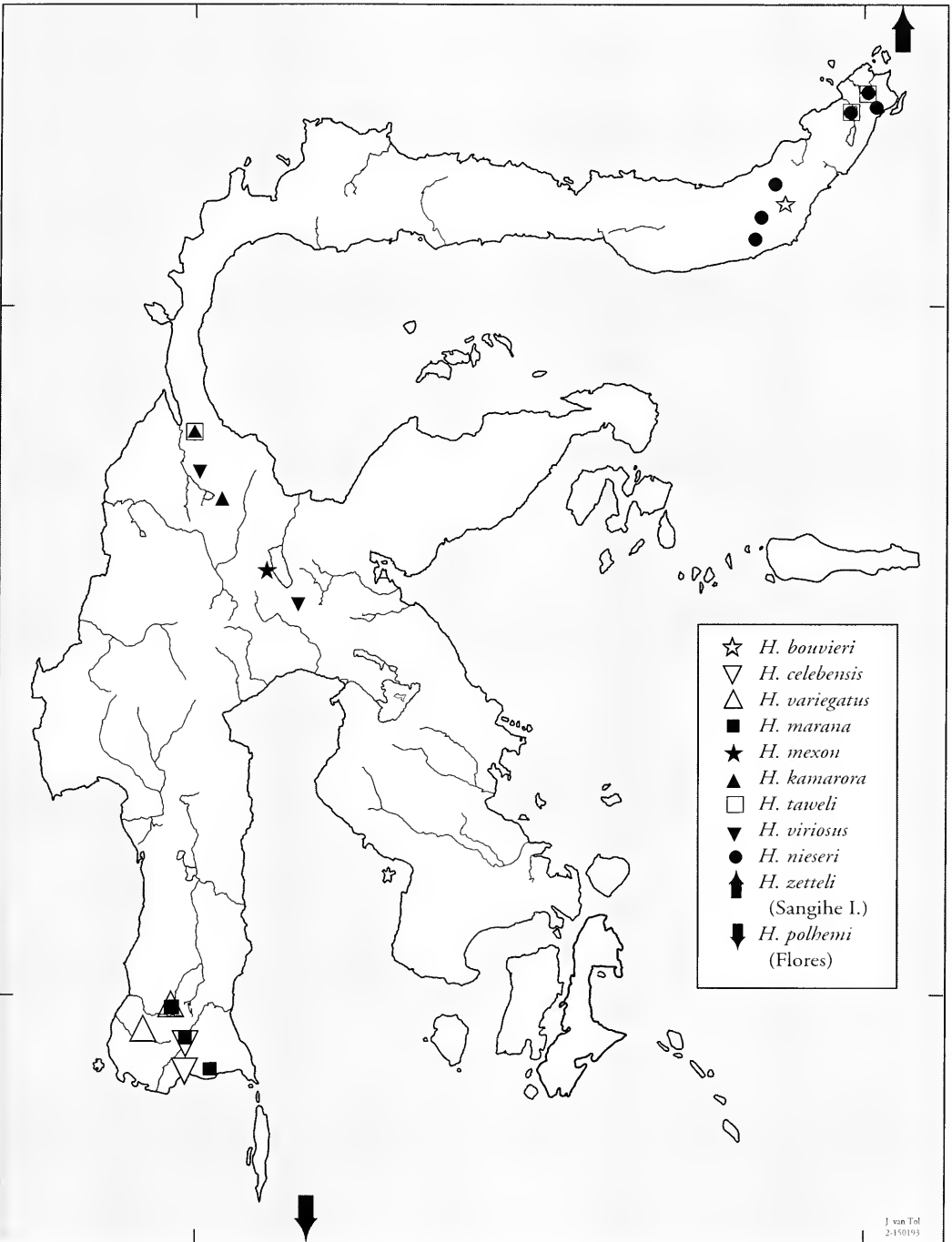
This family has been treated in our first paper on Sulawesi water bugs (Nieser & Chen 1991) and the Sulawesi fauna of the genus *Enithares* Spinola has been revised by Nieser & Chen (1996). That leaves to report on some additional material and presenting a key to the genus *Anisops* Spinola.

The tylus is the area between anterior angles of eyes and base of labrum; the term was introduced by Truxal (1953) in his revision of the sister group, *Buenoa* Kirkaldy. Brooks (1951) uses the term facial tubercle for the tylus. In *Anisops* instead of ocular index based on synthlipsis, the ocular index based on vertex (ocular index (V) Nieser 1975) is used.

The species of *Anisops* recorded so far from Sulawesi are, with the possible exception of *A. salibabu* sp. n., more or less widespread species many of which have adapted to environments in agricultural areas. There are still several species with disjunct distribu-



Figs. 118-125. *Helotrephes otoeis*, holotype male (118-123; 125), allotype female (124). – 118, habitus lateral view; 119, cephalothorax frontal view; 120, habitus dorsal view; 121, dorsal paramere; 122, ventral paramere; 123, ventral median carina; 124, subgenital plate; 125, cephalothorax in lateral view. – Scales 118-120, 125: 1mm, 121, 122: 0.25 mm, 123, 124: 0.5 mm.



J. van Tol  
 2-150193

Fig. 126. Localities of *Hydrotrepes* species in Sulawesi.

tions such as India and New Guinea which may occur in Sulawesi or may be, when studied more closely, actually two related species. Such species have not been incorporated, so the following key is to be used with the usual care.

### Key to males of *Anisops* from Sulawesi

1. Small species, length 5.5 mm or less ..... 2
  - Larger species, length over 5.5 mm ..... 7
2. Tylus densely hairy, with longer hairs at the outside, length 4.7–5.0 mm, synthlipsis one third the anterior width of vertex .. *A. paracrinitus* Brooks, 1951
  - Tylus at most with a few hairs ..... 3
3. Small species, length 4.2–4.5 mm, with very narrow synthlipsis about one fifth the anterior width of vertex ..... *A. bironi* Brooks, 1951
 

[Remark: The exact identity of the specimens from Sulawesi referred to this species is somewhat in doubt (Nieser & Chen 1991). Specimens should also be compared with *A. rigoensis* Brooks, see Lansbury (1978) for extensive discussion of these species.]

  - Larger species, length 5 mm or more ..... 4
4. Tylus laterally compressed with a small lozenge-shaped fossa on top; synthlipsis slightly more than one third the anterior width of vertex ..... 5
  - Tylus neither compressed nor with a small lozenge-shaped fossa on top; length 5.2–5.4 mm, synthlipsis narrow 0.057–0.064 mm but as the vertex is also narrow the relative width of synthlipsis is about half anterior width of vertex ..... 6
5. Tylus dorsally produced into a distinct carina which continues on the anterior two thirds of frons between eyes, base of rostral prong not projecting anteriorly of fourth rostral segment (fig. 131), length 5.1–5.5 mm, ..... *A. tabitiensis* Lundblad, 1934
  - Tylus dorsally at most with an indication of a carina which does not extend between eyes, base of rostral prong distinctly projecting in front of fourth rostral segment (fig. 129), length 5.2–5.9 mm ..... *A. rhomboides* sp. n.
6. Fore tarsus without a row of small teeth ..... *A. salibabu* sp. n.
  - Fore tarsus with a short row of three small teeth in basal half ..... *A. philippinensis* Brooks, 1951
7. Eyes touching each other (holoptic) posteriorly for over one fourth the length of head, fore femur very thick, length 5.7–6.6 mm ..... *A. breddini* Kirkaldy, 1901a
  - Synthlipsis sometimes very narrow but eyes not holoptic ..... 8
8. Large species, length over 6.5 mm ..... 9
  - Medium sized species, length 5.5–6.5 mm .... 10

9. Length 9 mm or more, in dorsal view frons extending anteriorly of eyes forming a short cephalic horn, base of middle tibia with a short inward projection bearing apically a circular group of stout thickly set setae ..... *A. stali* Kirkaldy, 1904
  - Length 6.5–7.2 mm, in dorsal view head anteriorly rounded ..... *A. occipitalis* Breddin, 1905
10. In dorsal view vertex projecting in front of the eyes forming a cephalic projection ..... 12
  - In dorsal view anterior margin of head almost straight ..... 11
11. Tylus laterally compressed with a small lozenge-shaped fossa on top (see also couplet 5) ..... *A. rhomboides* sp. n.
  - Tylus slightly swollen, not laterally compressed; length 5.4–5.8 mm (see also couplet 6) ..... *A. philippinensis* Brooks, 1951
12. In frontal view frons with an oval excavation dorsally of eyes, claws of middle leg of the same shape, length 6.0–7.8 mm ..... *A. nasutus* Fieber, 1851
  - In frontal view frons excavated between and above eyes, claws of middle leg of different shape, one long narrow and smoothly curved the other shorter thicker and sinuate ..... *A. kuroiwae* Matsumura, 1915

[Remark: this species is widely known under its junior synonym *A. batillifrons* Lundblad, 1933]

### *Anisops nasutus* Fieber

*Anisops nasuta* Fieber, 1851b: 60–61.

*Anisops nasuta*; Nieser & Chen 1991: 57.

Material. – INDONESIA, Sulawesi Utara, Dumoga Bone N.P., Base Camp, XI.1985, 2♂, leg. G. Zimmermann.

Distribution. – E. India through SE Asia, China, Philippines and Indonesia to New Guinea and Australia also widespread in Pacific Isles.

### *Anisops occipitalis* Breddin

*Anisops occipitalis* Breddin, 1905b: 152.

*Anisops occipitalis*; Nieser & Chen 1991: 57.

Material. – INDONESIA, Sulawesi Utara, Dumoga Bone N.P., Base Camp, at light, 2.xi., 1♂; Base camp XI.85, 2♂ 5♀; Lakes, kleiner See, Fischteich (small lake, fish pond) 1985, 1♂. All leg. G. Zimmermann, 1985. Maluku, Ceram, Umg. Wahal, 12.ii.1989, 2♀, leg. M. Jäch (NHMW).

Distribution. – From SE China including Taiwan through Indonesia to New Guinea, Australia and

New Caledonia, if Lansbury (1965) is correct in supposing that *A. leucotheca* Esaki is a synonym then it is also widespread in Pacific Islands.

### *Anisops paracrinitus* Brooks

*Anisops paracrinita* Brooks, 1951: 329-331.  
*Anisops paracrinita*; Nieser & Chen 1991: 57-58.

Material. – INDONESIA, Sulawesi Utara, sawah near Dumoga Bone N.P., 10.xi.1985, 2♂ 7♀ leg. G. Zimmermann. Sulawesi Tengah, Fluß 20 km N. Palu, 10.ii.1995, 2♂ 4♀ leg. Seyfert & Greindl (66) (NHMW).

Distribution. – Described from E. Australia, widespread in Indonesia.

### *Anisops tabitiensis* Lundblad (fig. 131)

*Anisops tabitiensis* Lundblad 1934b: 121-123.  
*Anisops tabitiensis*; Nieser & Chen 1991: 58.

Material. – PAPUA NEW GUINEA: New Guinea, Lae, 28.ii.1956, 1♂ 1♀, leg. E. S. Brown; West New Britain, Tamaro Creek, 5.xi.1989, 1♂ leg. R. Prior. – SOLOMON ISLANDS: Ontong Java Kemaru, 30.i.1955, 2♂, leg. E. S. Brown (NCTN); NEW HEBRIDES: Esp. Santo Is., Hog Harbour, 1♂, leg. Baker & Sladen (OXUM), all det. I. Lansbury.

Remarks. – Length ♂ 5.22 (Solomon); 5.60 (PNG), 5.90 (Nw Hebr.), 5.88 (PNG). Brooks (1951) states that the tibial comb in males has 'approximately twenty-one teeth', however, specimens checked have about 30, in accordance with Lundblad (1934b). Lansbury (1964) gives 23-34 and suggests that *A. tabitiensis* as presently conceived may contain more than one species which 'cannot at present be satisfactorily separated'. See below under *A. rhomboides* sp. n. also for distribution.

### *Anisops stali* Kirkaldy

*Anisops stali* Kirkaldy, 1904: 113, 132.  
*Anisops stali*; Nieser & Chen 1991: 58.

Material. – INDONESIA, Sulawesi Utara, Dumoga Bone N.P. Base Camp. XI.1985, 1♂ 2♀, leg. G. Zimmermann.

Distribution. – From Australia through Indonesia and Mindanao to SE China (including Taiwan) and Okinawa.

### *Anisops rhomboides* sp. n. (figs. 127-130)

[*Anisops tabitiensis* Lundblad sensu Nieser & Chen, 1991: 58. Misidentification]

Type Material. – Holotype male (NCTN), dark form: BRUNEI DARUSSALAM, Labi Road 29.5 km, wet bracken/sedge field, small shallow pond overgrown with *Eleocharis*, up to 0.3 m deep, water clear light brown, 15 April 1993, N9342B, leg. N. Nieser. – Paratypes: 14♂ 8♀: same data as holotype 3♂ 3♀ (including allotype, 1♂ 1♀ BMKB). – INDONESIA, Sulawesi Tenggara, P. Buton, Desa Gareng-Gareng, dirty pond in village, some small shrubs and grasses, 8. III. 1989, N8938, leg. N. Nieser 3♂. Sulawesi Utara, Danau Linow, sulphur lake at Lahendong, sampled around some tufts of *Eleocharis*, depth 0.2m, no other vegetation, 10. XII. 1994, 2♂, leg. N. Nieser. Sulawesi {Tengah}, river S. Palu, 27.i.1995, 1♂ leg. Seyfert & Greindl (NHMW). – PHILIPPINES, Mindanao, Lake Sebu, village pond next to market, circular pond, diameter about 100m, the actual moat 5-10 m wide, mostly shallow but a few water buffalo washing holes, central isle half dry half marsh, moat with varied vegetation, *Potamogeton gramineus*-group, *Callitriche* like plant and various Cyperaceae, also vegetation overhanging from banks, 7.xii.1993, N9374, leg. N. Nieser, 5♂ 5♀ (2♂ 2♀ NCTN, 1♂ 1♀ OXUM, 1♂ 1♀ RMNH, 1♂ 1♀ ZMAN).

### Description

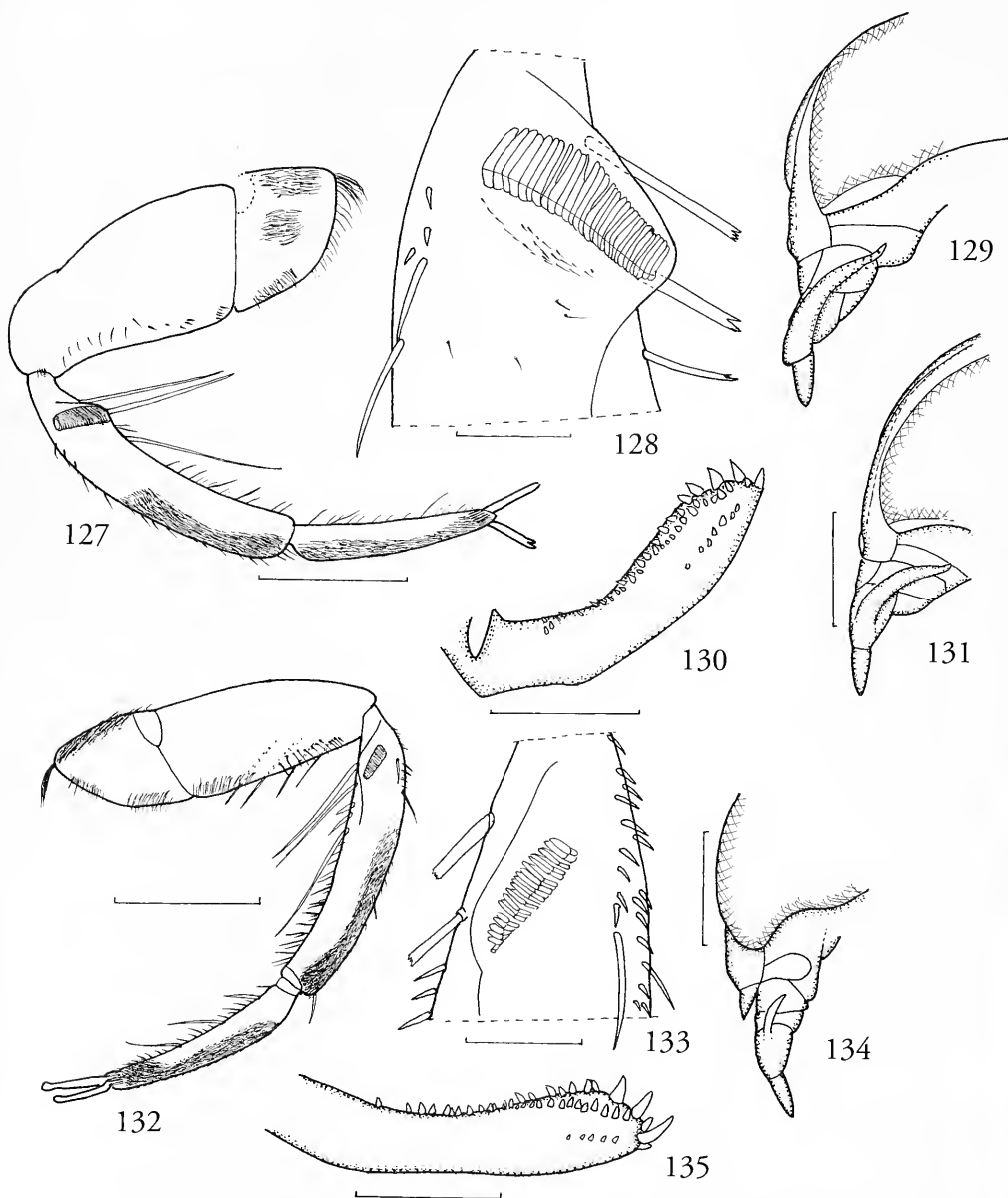
Dimensions, length ♂ 5.20-5.56-5.90 ♀ 5.50-5.67-6.25; width of head ♂ 1.25-1.29-1.32 ♀ 1.28-1.31-1.40; width of pronotum ♂ 1.32-1.38-1.50 ♀ 1.32-1.44-1.60; anterior width of vertex ♂ 0.18-0.20-0.21 ♀ 0.19-0.23-0.26; synthlipsis ♂ 0.056-0.065-0.075 ♀ 0.081-0.091-0.113.

Colour (based on alcohol-preserved specimens), dark form, generally dark, head pale with blackish eyes (in dry specimens the eyes become pale grey), tylus and rostrum variable pale to dark, fourth rostral segment always blackish, pronotum pale but transparent showing underlying dark mesonotum, scutellum pale, hemelytra and hind wings entirely hyaline, hind wings usually iridescent, the dorsum of abdomen shining through wings, dorsum of abdomen dark, in most specimens a pale area in the middle; thoracic venter pale, abdominal venter blackish with inner margin of connexiva and rim of median abdominal keel yellow, legs variable from light brown to black with outer borders pale.

Labrum three quarters as long as its basal width (0.15/0.20) bare, apex rounded; eyes longer than median length pronotum (0.92/0.75). Pronotum,

humeral width twice its median length (1.4/0.7) with lateral margins diverging posteriorly, half as long as its median length (0.35/0.72); posterior margin convex, medianly shallowly emarginate. Scutellum large, four

fifth as long as its basal width (1.00/1.25). Posterior femur with 19-25 spine-like setae in dorso-posterior and 35-40 in ventro-posterior row. Length of leg segments as in table ♀♀.



Figs. 127-135. *Anisops* spp., details. – 127-130, *A. rhomboides* male paratype (127-129), female paratype (130): 127, fore leg; 128, proximal part of fore tibia with tibial comb; 129, head in lateral view; 130, ovipositor; 131 *A. tabitiensis*, male, head in lateral view; 132-135, *A. salibabu*, male paratype (132-134), female paratype (135): 132, fore leg; 133, proximal part of fore tibia with tibial comb; 134, head in lateral view; 135, ovipositor. – Scales: 128, 133: 0.1mm, 127, 129, 131, 132, 134: 0.5 mm, 130, 135: 0.25 mm.

Male structural characteristics, in dorsal view the lateral margins of head parallel with anterior margin nearly straight and vertex level with eyes, width of head 0.9 times the humeral width of pronotum (1.3/1.4), just under seven times the anterior width of vertex (6.0-6.9, ocular index (V) = 0.37); synthlipsis on average just over one third the anterior width of vertex (0.28-0.36). Along median axis, median length of head equal to slightly shorter than median length of pronotum (0.89-1.04). Tylus laterally compressed resulting in a somewhat conical elevation, apically with a shallow lozenge-shaped fossa, dorsally with an indication of a carina which does not continue between eyes. Rostral prong (fig. 129) with base originating near distal end and distinctly projecting in front of fourth rostral segment; twice the length of third rostral segment (0.55/0.28), including the part laterally on third rostral segment) apex acuminate and in most specimens somewhat sinuate. Stridulatory comb on fore tibia (figs. 127, 128) consisting of 28-32 teeth gradually increasing in size towards anterior margin of tibia. Fore tarsus without row of small pegs.

Female structural characteristics. Head parallel-sided to very slightly diverging posteriorly, nearly six times as wide as anterior width of vertex (1.32/0.23, ocular index (V) = 0.43), its median length equal to shorter than median length of pronotum (0.83-1.0), synthlipsis two fifth the anterior width of vertex (0.09/0.23). Ovipositor fig. 130.

### **Etymology**

*Rhomboides* refers to the lozenge shaped fossa on tylus.

### **Comparative notes**

Similar to *A. tahitiensis* Lundblad which, however, in males has a distinct keel running from tylus upward between eyes and rostral prong not projecting in front of fourth rostral segment (fig. 131). Females of *A. tahitiensis* have a relatively slightly wider synthlipsis (half anterior width of vertex) and head three fifth the length of pronotum. If our concept is correct *A. tahitiensis* is distributed from New Guinea through Melanesia to Tahiti and *A. rhomboides* around the Sulawesi Sea.

### ***Anisops salibabu* sp. n.** (figs. 132-135)

Type Material. – Holotype male (NCTN), dark form, INDONESIA, Sulawesi Utara: Pulau Salibabu, Lirung, nearly dry stream on hill shaded by remnants of forest, small shallow pools of water with much plant debris connected by a trickle of water, 24.xi.1994, N9483. – Paratypes (adults only): 18 ♂

17 ♀: Same data as holotype 4 ♂ 6 ♀ dark form, 2 ♂ 1 ♀ light form, 2 lvV. (NCTN); P. Sangir, Salurang, roadside pond with *Nymphaea*, 20.xi.1994, N9482, leg. N. Nieser, 5 ♂ 5 ♀ (2 ♂ 2 ♀ NCTN, 1 ♂ 1 ♀ NHMW, 1 ♂ 1 ♀ OXUM, 1 ♂ 1 ♀ SEMC). P. Karakelong, Ambela, first part of irrigation trench, shaded, no aquatic vegetation, 28.xi.1994, N9494, 3 ♂ 1 ♀ 2lvV (1 ♂ 1 ♀ MBBJ, 2 ♂ NCTN). Dumoga Bone N.P. area, lakes, kleiner See, Fischteich (small lake, fish pond) 1985, 4 ♂ 4 ♀ leg. G. Zimmermann (1 ♂ 1 ♀ NCTN, 1 ♂ 1 ♀ RMNH, 1 ♂ 1 ♀ ZC, 1 ♂ 1 ♀ ZMAN).

Remark: The localities in the Sangir/Talaud isles are all rather small stagnant shaded waters in or at the edge of woodland.

### **Description**

General shape, a small broad-headed species, body fusiform with greatest width at the level of apex of scutellum. Dimensions (measurements taken from alcohol-preserved specimens), length ♂ 5.2-5.28-5.4 ♀ 5.2-5.59-5.8; width of head ♂ 1.30-1.27-1.28 ♀ 1.23-1.35-1.40; humeral width of pronotum ♂ 1.30-1.31-1.35 ♀ 1.38-1.48-1.55; anterior width of vertex ♂ 0.12-0.14-0.15 ♀ 0.19-0.21-0.24; synthlipsis ♂ 0.056-0.058-0.064 ♀ 0.081-0.092-0.100.

Colour (based on alcohol specimens), pale form, hemielytra hyaline except for a slight infuscation at base, body pale yellowish except for eyes, rostrum, posterior part of abdominal dorsum, most of abdominal sternites (except median carina) and bands along the sutures of connexiva, which are brown-grey to blackish. Dark form as light with additional dark areas: meso- and metanotum including scutellum and base of abdomen brown to dark brown, connexiva predominantly brown. Although all specimens are morphologically macropterous, only the dark form has developed indirect flight muscles. The thoracic pigmentation of the dark form develops during teneral development, judging from our material, in about the same pattern as in *Corixidae* (Young 1965) and *Gerris* (Andersen 1973). One of the male light form specimens from N9483 had just moulted and had developing indirect flight muscles, the others apparently had the spongy tissue indicating permanently reduced flight muscles. No systematic differences in ratios between measurements have been found between the dark and light form.

Structural characteristics, labrum over half as long as wide (0.14/0.23), with a few small semierect bristles (usually 3-5, but they easily rub off), apex obtuse. Eyes a quarter of their length longer than median length pronotum (0.95/0.75). Pronotum twice as wide as its median length (1.40/0.66), lateral margins diverging posteriorly, half as long as median length (0.33/0.66).

Male structural characteristics, in dorsal view the outline of the head is rounded with anterior margin nearly straight and vertex only slightly indented, width of head 0.95–1.0 times the humeral width of pronotum, 8–10 times the anterior width of vertex (8.2–10.1, ocular index ( $V$ ) = 0.25); synthlipsis over one third the anterior width of vertex (0.37–0.45). Along median axis, head longer than pronotum (0.76/0.65). Humeral width of pronotum twice its median length (1.31/0.65); lateral margins diverging somewhat about half its median length (0.35/0.65); posterior margin convex, medianly emarginate. Tylus moderately swollen, labrum two thirds as long as its basal width (0.13/0.19) with a few bristles, apex rounded. Rostral prong (fig. 134) with base originating near proximal end and three quarters the length of third rostral segment, apex acuminate. Stridulatory comb on fore tibia (figs. 132, 133) consisting of 19–23 teeth gradually increasing in size towards anterior margin of tibia. At the base of the comb (towards posterior margin of tibia) there are 0–4 isolated much smaller teeth. Tarsus without small pegs on its inner surface. Length of leg segments as in table 1.

Female structural characteristics. Head parallel-sided, anteriorly truncate with vertex slightly indented, width of head six and a half times as wide as anterior width of vertex (5.8–6.9, ocular index ( $V$ ) = 0.36), its median length shorter than median length of pronotum (0.71–0.99), synthlipsis slightly less than half the anterior width of vertex (0.09/0.21).

### **Etymology**

*Salibabu*, a noun in apposition refers to the island where the holotype was collected.

### **Comparative notes**

*A. salibabu* belongs to the *A. philippinensis*-group, small species with no distinct characteristics. Dr. Lansbury wrote us that he formerly included some populations from the Australian region in *A. philippinensis* Brooks (Lansbury 1964, 1978) but that he is now inclined to consider these different species. The main difference between *A. salibabu* and *A. philippinensis* is the lack of small pegs on male fore tarsus in *A. salibabu*. Moreover, the median length of head in *A. philippinensis* is shorter to equal median length of pronotum and the number of teeth in the male tibial comb seems to be less (17).

### ***Enithares bakeri* Brooks**

*Enithares bakeri* Brooks, 1948: 40.

*Enithares bakeri*; Nieser & Chen 1991: 59.

Material. – INDONESIA, Sulawesi Utara, Dumoga Bone N.P., area, 5 localities, X–XI.1985, leg. G. Zimmermann.

Sulut, P. Sangihe, Salurang, roadside pond with *Nymphaea*, 20.xi.1994, N9482, leg. N. Nieser, 5♂ 1lvV. P. Karakelong, Ambela, first part of irrigation trench, shaded, no aquatic vegetation, 28.xi.1994, N9494, 4♂ 1lvV., leg. N. Nieser

### ***Enithares ektakta* Nieser & Chen**

*Enithares ektakta* Nieser & Chen 1996: 161–174.

Material. – INDONESIA, Sulawesi Utara, Pulau Sangihe, Lelepu, Sungai Lelepu, lowland stream, *Enithares* from small rather deep (0.3 m) pools at edge of stream, hidden under overhanging vegetation, 13. XI. 1994, N9464, 2♂ 2♀, leg. N. Nieser

### ***Enithares producta* Lansbury**

*Enithares producta* Lansbury 1968: 368–369.

*Enithares producta*; Nieser & Chen 1991: 59; Nieser & Chen 1996: 172.

Material. – INDONESIA, Sulawesi Utara, Dumoga Bone N.P., Tumpah, Staustufe {weir}, 23.x.1985, 3♂ 6♀ 2lvv; Danau Alea 22.xi. 2♂ 24♀ 3lvIV 1lvV. All leg. G. Zimmermann 1985.

### ***Nychia sappho* Kirkaldy**

*Nychia marshalli* var. *sappho* Kirkaldy, 1901b: 809–810.

*Nychia sappho*; Lansbury, 1985: 4–5; Nieser & Chen 1991: 64.

Material. – INDONESIA, Sulawesi Utara, Dumoga Bone N.P., lakes, kleiner See, Fischteich {small lake, fish pond}, 1985, 1♀ macr. leg. G. Zimmermann

### **DISCUSSION OF THE SULAWESI FAUNA OF NEPOMORPHA (see table 2)**

The most obvious characteristic of the Sulawesi fauna of Nepomorpha is the paucity of Naucoridae s.str. This is especially interesting as New Guinea has a very rich fauna with seven endemic genera and numerous species (La Rivers 1971a), the Philippines have five genera of which three are endemic (D. & J. Polhemus 1987) with some ten species of which several are still undescribed (J.T. Polhemus in litt.) and to the west the Laccocorinae are well represented (La Rivers 1971b). As collecting in recent years has been quite intensive it is quite probable that the Naucoridae s. str. in Sulawesi are effectively restricted to *Naucoris scutellaris*. For this reason the species of Naucoridae occurring in the Sunda islands have been lumped to genera in table 2. The Aphelocheiridae are with

four species reasonably well represented compared to one each in Irian, Mindanao and Jawa, two in Borneo and so far one in Sumatra although one or two of the W. Malaysian species which have ample distribution into Thailand (see table 2) may be found to extend their range into Sumatera. The relative abundance of Aphelocheiridae may partly be due to quite intensive collecting, in which especially the stream fauna has not been neglected, in Sulawesi compared to some of the other islands. Both Bornean species, e.g., have been found in the same area and most of Kalimantan has hardly been sampled with respect to water bugs. In New Guinea, with its rich fauna of Naucoridae, possibly most niches were occupied before *Aphelocheirus* reached the island. This implies that Naucoridae would be a much older group than Aphelocheiridae, which in view of the world distribution (Naucoridae world-wide, Aphelocheiridae Old World but poorly represented in the Australian and European subregions) and the large number of autapomorphic characteristics found in this family (Mahner 1993) could be the case. The fossil record does not help much as no fossils have been attributed to Aphelocheiridae so far. To apply the inverse argument for Sulawesi, *Aphelocheirus* reached this island before stream inhabiting Naucoridae did, which leaves the question why, as the island is surrounded by a rich and diverse Naucorid fauna.

A second more general feature are the distinct differences in distribution area of species of various genera. Species of *Aphelocheirus*, *Enithares* and *Hydrotrepes* tend to have restricted distributions which results in most of them being endemic in the quite large areas used in table 2. Of these *Enithares* and *Hydrotrepes* are very richly represented in Sulawesi and most of the endemic species seem to be restricted to a small part of the island, although as in many cases these species are only known by their type series, this pattern may change somewhat in the future. The peculiar shape of Sulawesi may be the main cause. The complicated geological history of Sulawesi seems to have had less influence on this aspect as the number of species per area appears to be the same in parts of different geological origin. This would mean that these species have evolved after the island got its present composition and that the speciation is more closely related to the more recent bottle necks to gene flow than to more ancient geological isolation (J. & D. Polhemus 1990). The origin of the fauna is apparently from the SE Asian mainland through the Sunda isles. Characteristic and richly represented taxa in the Australian-New Guinea fauna (Gelastocoridae, Naucoridae, Ochteridae) do not seem to have spread westward.

As far as known at present a number of genera has reached Borneo or Jawa & Nusa Tenggara, or both,

but not Sulawesi: *Distotrephes*, *Helotrephes*, *Idiotrepes*, *Heleocoris*, *Laccocoris* and *Aphelonecta*. The same pattern is true for genera of Gerromorpha (J. & D. Polhemus 1990). Initially it could be supposed that this may also have contributed to the relative abundance of species of *Enithares* and *Hydrotrepes* in Sulawesi. When their first representatives reached Sulawesi they may have found good niche opportunities due to the absence of related forms. But if the pattern of a large number of species each with their own small distribution area is confirmed, as is seen especially in *Enithares* (Nieser & Chen 1996) then local geographical isolation would be the main candidate for the driving force behind the species richness of these genera in Sulawesi (J. & D. Polhemus 1990).

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Table 2. Distribution catalogue of Nepomorpha found in Indonesia and adjacent areas.

As the study centers on Sulawesi, New Guinean species have only been incorporated when they have also been found west of New Guinea. Likewise for the Naucoridae, which probably will not have representatives in Sulawesi, the distribution is only presented per genus.

Abbreviations: Ba = Bali, Bo = the Island of Borneo, I = New Guinea, J = Jawa, Ma = Maluku, Mi = Mindanao, N = Nusa Tenggara, R = note, see under the number below the table, Sl = Sulawesi, Sm = Sumatera, W= West Malaysia (+Singapore); abbreviations + = endemic, ● recorded, ? questionable record, number under R = see Remarks

	W	Sm	J	Ba	N	Bo	Sl	Ma	I	Mi	R
<b>Aphelocheiridae</b>											
<i>Aphelocheirus</i> Westwood											
<i>bengkulu</i> D. Polhemus							+				
<i>celebensis</i> Polhemus & Polhemus							+				
<i>femoratus</i> Polhemus & Polhemus	●										1
<i>geros</i> Nieser & Chen							+				
<i>grik</i> Polhemus & Polhemus	●										1
<i>javanicus</i> Polhemus & Polhemus			+								
<i>kinabalu</i> Polhemus & Polhemus						+					
<i>lorelindu</i> Polhemus & Polhemus							+				
<i>malayensis</i> Polhemus & Polhemus	+										
<i>minor</i> Polhemus & Polhemus						+					
<i>robustus</i> Nieser & Chen							+				
<i>zamboanga</i> Polhemus & Polhemus										+	
<b>Belostomatidae</b>											
<i>Diplonychus</i>											
<i>rusticus</i> (Fabricius)	●	●	●	●	●	●	●			●	
<i>Lethocerus</i>											
<i>indicus</i> (Lepetelier & Serville)	●	●	●			●	●			●	
<b>Corixidae</b>											
<i>Agraptacorixa</i> Kirkaldy											
<i>hyalinipennis</i> (Fabricius)	●	●	●					●			2
<i>Sigara</i> Fabricius											
<i>connexa</i> Lundblad		●	●								3
<i>insulana</i> Lunblad		●	●								
<b>Helotrephidae</b>											
<i>Distotrephes</i>											
<i>heveli</i> J. Polhemus						+					
<i>kodadai</i> Zettel						+					
<i>sarawakensis</i> Zettel						+					
<i>Fischerotrephes</i>											
<i>depressus</i> Zettel						+					
<i>jaechi</i> Zettel	+										
<i>Helotrephes</i>											
<i>otoeis</i> sp. n.						+					
<i>Hydrotrephe</i>											
<i>angulatus</i> (China)		+									
<i>bouvieri</i> (Kirkaldy)							+				
<i>celebensis</i> J. Polhemus							+				
<i>corporaali</i> (China)		+									
<i>kamarora</i> J. Polhemus							+				
<i>marana</i> J. Polhemus							+				
<i>martini</i> (Kirkaldy)		+									
<i>mexon</i> sp. n.							+				
<i>nieseri</i> J. Polhemus							+				
<i>pardalos</i> sp. n.										+	
<i>polhemusi</i> sp. n.					+						4
<i>stereos</i> sp. n.										+	
<i>taweli</i> J. Polhemus							+				
<i>variegatus</i> J. Polhemus							+				
<i>viriosus</i> J. Polhemus							+				
<i>zetteli</i> sp. n.							+				5

<i>Idiotrephes chinai</i> Lundblad	●	●																																6
sp.n. (Zettel 1995b)															+																			
<i>Tiphotrephes indicus</i> (Distant)	●																																	7
Micronectidae																																		
<i>Micronecta kirkaldy aleksander</i> sp. n.															+																			
<i>fugitans</i> Lunblad	●	●																																8
<i>grisea</i> (Fieber)	●	●																																9
<i>haliploides</i> (Horváth)	●	●																																10
<i>kymatista</i> sp. n.																																		
<i>ludibunda</i> Breddin	●																																	
<i>pachymychi</i> sp. n.																																		
<i>quadrivirgata</i> Breddin	●	●																																11
<i>siva</i> (Kirkaldy)		●																																12
<i>skutalis</i> sp. n.																																		
<i>tarsalis</i> L. Chen																																		13
<i>virgata</i> Hale																																		14
<i>Synaptonecta issa</i> (Distant)	●																																	
Naucoridae																																		
<i>Ctenipocoris</i>	●																																	15
<i>Coptocatus</i> Montandon																																		16
<i>Heleocoris</i>	●	●																																17
<i>Laccocoris</i> Stål	●	●																																18
<i>Naucoris</i> Fabricius																																		
<i>scutellaris</i> Stål	●	●																																
Nepidae																																		
<i>Cercotmetus</i> Amyot & Serville																																		
<i>asiaticus</i> Amyot & Serville	●	●																																19
<i>brevipes</i> Montandon		●																																20
<i>compositus</i> Montandon		●																																21
<i>robustus</i> Montandon																																		
<i>Laccotrephes</i> Stål																																		
<i>celebensis</i> Polhemus & Keffer																																		
<i>grossus</i> (Fabricius)	●	●																																
<i>papuius</i> Montandon																																		
<i>pfeiferiae</i> (Ferrari)	●	●																																
<i>robustus</i> Stål																																		22
<i>sondaicus</i> Polhemus & Keffer																																		22
<i>Ranatra</i> Fabricius																																		
<i>akoitachta</i> Nieser																																		
<i>diminuta</i> Montandon																																		23
<i>longipes</i> Stål		●																																24
<i>malayana</i> Lundblad																																		
<i>natunaensis</i> Lansbury																																		25
<i>parmata</i> Mayr		●																																26
<i>spinifrons</i> Montandon																																		
<i>stali</i> Montandon																																		27
<i>sulawesii</i> Nieser & Chen																																		28
<i>varipes</i> Stål	●	●																																29
Notonectidae																																		
<i>Anisops</i> Spinola																																		
<i>biroi</i> Brooks																																		
<i>breddini</i> Kirkaldy	●																																	30
<i>cleopatra</i> Distant		●																																31
<i>kuroiwaiae</i> Matsumura																																		32
<i>lombokensis</i> Brooks																																		
<i>nasutus</i> Fieber	●	●																																
<i>nigrolineatus</i> Lundblad																																		33

<i>niveus</i> (Fabricius)		●									34
<i>occipitalis</i> Breddin	●	●	●	●	●	●	●	●			
<i>paracrinus</i> Brooks		●	●	●	●	●					
<i>philippinensis</i> Brooks									●		35
<i>rhomboides</i> sp.n.						●	●		●		
<i>salibabu</i> sp. n.							+				
<i>stali</i> Kirkaldy			●	●	●		●		●		
<i>sutteri</i> Brooks					+						
<i>thienemanni</i> Lundblad			●								36
<i>Aphelonecta</i> lansbury											
<i>alexis</i> Lansbury						+					
<i>gavini</i> Lansbury	●										37
<i>gigas</i> Zettel						+					
<i>jaechi</i> Zettel		+									38
<i>nakatae</i> Lansbury						+					
<i>Enithares</i> Spinola											
<i>bakeri</i> Brooks					●	●	●	●	●	●	
<i>bubleri</i> Brooks					+						
<i>caesaries</i> Nieser & Chen							+				
<i>charakia</i> Nieser & Chen							+				
<i>ekakta</i> Nieser & Chen							+				39
<i>genitalis</i> Lundblad			●								40
<i>hippokleides</i> Kirkaldy			+								
<i>horvathi</i> Kirkaldy							+				
<i>intricata</i> Breddin		●	●								
<i>lansburyi</i> Nieser & Chen							+				
<i>lombokensis</i> Lansbury					+						
<i>maai</i> Lansbury						+					
<i>malayensis</i> Brooks	+										41
<i>mandalayensis</i> Distant	●										43
<i>margarethae</i> Nieser & Chen							+				
<i>martini</i> Kirkaldy									●		42
<i>megalops</i> Lansbury								●	●		
<i>paramegalops</i> Lansbury							●	●	●		
<i>phenakismos</i> Nieser & Chen							+				
<i>producta</i> Lansbury							+				
<i>ripleyana</i> Lansbury								+			
<i>skutalis</i> Nieser & Chen							+				
<i>stansae</i> Nieser & Chen							+				
<i>subparallela</i> Lansbury										+	
<i>thienemanni</i> Lundblad		+									
<i>timorensis</i> Brooks					+						
<i>uncata</i> Lundblad		●	●								43
<i>vicintricata</i> Lansbury						+					
<i>Nychia</i> Stål											
<i>sappho</i> Kirkaldy	●	●	●		●	●		●			44

**Ochteridae**

<i>Ochterus</i> Latreille											
<i>grandiusculus</i> Nieser & Chen						+					
<i>homorfos</i> sp. n.						+					
<i>marginatus</i> (Latreille)	●	●	●		●	●			●		
<i>noualhierii</i> Baehr			●			●					
<i>pardalos</i> sp. n.										+	
<i>surigaoensis</i> Gapud										+	
<i>thienemanni</i> Jaczewski		●	●	●							
<i>trichotos</i> sp. n.						+					
<i>xustos</i> Nieser & Chen					+						

**Pleidac**

<i>Paraplea</i> Esaki & China											
<i>frontalis</i> (Fieber)		●	●		●	●	●	●		●	
<i>liturata</i> (Fieber)			●	●			●				

W Sm J Ba N Bo Sl Ma I Mi R

## Remarks

1. *Aphelocheirus femoratus* and *A. grik* reach into NW Thailand.
2. *Agraptacorixa hyalinipennis* is a very widespread species, from Pakistan through India and Myanmar to Taiwan, Okinawa and New Guinea (Jaczewski 1962). The New Guinea record should be verified, however.
3. *Sigara connexa* has also been recorded from Myanmar and Vietnam.
4. *Hydrotrepes polhemusi* known from Flores only.
5. *Hydrotrepes zetteli* known from Sangir island only.
6. *Idiotrepes chinai* also known from several localities in Thailand (Zettel 1995b).
7. *Tiphotrephes indicus* has been recorded from India, Myanmar, Thailand and W. Malaysia.
8. *Micronecta fugitans* has also been recorded from Thailand.
9. *Micronecta grisea* has been recorded from India and Sri Lanka through Vietnam to Taiwan.
10. *Micronecta halipoides* has been recorded from NE India and Sri Lanka through Thailand to Vietnam.
11. *Micronecta quadristrigata* one of the most widespread species, from Iran through India to Taiwan, the Philippines and N. Australia.
12. *Micronecta siva* has been recorded from India, Sri Lanka, Myanmar and Vietnam.
13. *Micronecta tarsalis* has been recorded from S. India, Sri Lanka and Vietnam.
14. *Micronecta virgata* has been recorded from Australia and Pacific islands.
15. *Ctenipocoris* has also some S. American representatives (D. Polhemus 1987).
16. *Coptocatus*, 4 species restricted to N. Borneo (D. Polhemus 1986, Nieser & Chen 1991).
17. *Helecoris*, 6 species and subspecies in the area under consideration (La Rivers 1971b, 1974, Nieser & Chen 1992b).
18. *Laccocoris*, 5 species of which four are restricted to N. Borneo in the area under consideration.
19. *Cercometus asiaticus* reaches NW Thailand, we have seen 2♂ 1♀ from the Philippines, Palawan, Busuanga, 24-29.II.1996 leg. H. Zettel (ZPC), first record for the Philippines. The var. *longicollis* Mont. has, except for 1 specimen from W. Malaysia, so far only been recorded from Borneo.
20. *Cercometus brevipes*, Philippines, Mindanao, Agusan N. prov., Danau Mainit at Anibungan, 26.III.1993, N9321, leg. N. Nieser, 2♂ (NCTN) new record for Mindanao. Distribution from NW India through Thailand and Vietnam to SW China, Taiwan and Luzon.
21. *Cercometus compositus* occurs in SE Asia (Thailand, Laos, Cambodia, Vietnam) reaching Sumatera.
22. J. Polhemus & Keffer (1999) point out that *Laccotrephes robustus* is restricted to the Philippines, the widespread large species should be called *L. pfeifferiae*.
23. *Ranatra diminuta* has also been recorded from Luzon (J. Polhemus & Reisen 1978).
24. *Ranatra longipes* has two subspecies in Sulawesi, *R. l. celebensis* Lansbury (1972) which has only been collected in

Sulawesi Selatan; specimens from Sulawesi Tenggara belong to the nominal subspecies (Nieser & Chen 1991). We have seen 4♂ 4♀ of the nominal subspecies from the Philippines, Palawan, Busuanga, 23-24.II.1996 leg. H. Zettel (ZPC), first record for the Philippines.

25. *Ranatra natunaensis* Natuna Besar island only.
26. *Ranatra parmata* occurs also in Thailand and Laos.
27. *Ranatra stali* is endemic to the Philippines, mainly Mindanao with 1 record for Leyte and 2 for Luzon (Lansbury 1972, J. Polhemus & Reisen 1976).
28. *Ranatra sulawesii* has 2 subspecies, *R. s. sebui* Nieser & Chen (1996) restricted to Mindanao. The nominate subspecies has also been found in Thailand (new record for Thailand, locality in Thai script, KKUC).
29. *Ranatra varipes* is distributed through the countries bordering the Bay of Bengal extending S to Jawa.
30. *Anisops breddini* is distributed from India and Sri Lanka through SE Asia to Indonesia.
31. *Anisops cleopatra* was described from New Caledonia (Distant 1914) and later recorded from Jawa and Sumatera (Lundblad 1933), it has, however, never been found in between these areas so we doubt these populations belong to a single species.
32. *Anisops kuroiwae* is distributed from India through SE Asia to Hainan, Taiwan, Iriomote and the Philippines.
33. *Anisops nigrolineata*, although described from Jawa, is mainly known from India but distributed over Myanmar, Thailand and Sibuyan Island in the Philippines.
34. *Anisops niveus* mainly known from India and Sri Lanka, also occurring in Vietnam.
35. *Anisops philippinensis* has also been recorded from Luzon, records from the Australian Region probably refer to a different species, see comparative notes under *A. salibabu*.
36. *Anisops thienemanni* was described from Jawa and seems to be common in Australia. As it has not been found in the area in between we doubt if these populations belong to a single species.
37. *Aphelonecta gavini* is distributed from Malaysia through Thailand to Vietnam.
38. *Aphelonecta jaechi* is known by the unique holotype from Siberut Island (Zettel 1995c).
39. *Enithares ektakta* has been recorded from Sangir Island only.
40. *Enithares genitalis* has also been recorded from Luzon (J. Polhemus & Reisen 1978).
41. *Enithares malayensis* has been recorded from the Riau isles which belong politically to Indonesia, but for our purpose have been added zoogeographically to W. Malaysia.
42. *Enithares martini* is widespread in Mindanao including the Sulu Islands and has also been recorded from Luzon.
43. *Enithares uncata* and *E. mandalayensis* are very similar and their distributional areas seem to be exclusive, *E. uncata* restricted to Jawa and Sumatera, *E. mandalayensis* in continental SE Asia. Lansbury (1968) suggests that they may be different on subspecific level only.
44. *Nyehia sappho* extends into Australia & Continental SE Asia.

Table 1. Leg measurements of *Nepomorpha* in mm.

	femur	tibia <sup>1</sup>	tars1	tars2	claw					
<i>Micronecta aleksander</i>						<i>Hydrotrepes polhemii</i>				
fore leg ♂	0.23	0.125	0.13			fore leg ♂	0.93	0.85	0.30	0.10
middle leg ♂	0.59	0.20	0.28		0.18	middle leg ♂	0.91	0.72	0.32	0.09
hind leg ♂	0.39	0.31	0.31	0.16	0.09	hind leg ♂	0.90	1.06	0.32	0.29 0.11
fore leg ♀	0.24	0.24				fore leg ♀	0.95	0.82	0.30	0.10
middle leg ♀	0.59	0.23	0.30		0.16	middle leg ♀	0.89	0.68	0.31	0.10
hind leg ♀	0.39	0.31	0.32	0.13	0.09	hind leg ♀	0.96	1.08	0.36	0.31 0.12
<i>Micronecta kymatista</i>						<i>Hydrotrepes stereos</i>				
fore leg ♂	0.32	0.13	0.19			fore leg ♂	0.95	0.86	0.30	0.10
middle leg ♂	1.08	0.31	0.46		0.42	middle leg ♂	0.98	0.76	0.32	0.11
hind leg ♂	0.64	0.48	0.51	0.21	0.13	hind leg ♂	0.97	1.07	0.37	0.32 0.15
fore leg ♀	0.36	0.42				fore leg ♀	0.94	0.78	0.29	0.11
middle leg ♀	1.18	0.33	0.50		0.40	middle leg ♀	0.94	0.72	0.31	0.12
hind leg ♀	0.70	0.56	0.56	0.25	0.15	hind leg ♀	1.01	1.12	0.39	0.36 0.14
<i>Micronecta pachynychi</i>						<i>Hydrotrepes zetteli</i> (1♂ 3♀)				
fore leg ♂	0.26	0.12	0.13			fore leg ♂	1.00	0.83	0.30	0.09
middle leg ♂	0.66	0.21	0.33		0.22	middle leg ♂	0.90	0.75	0.25	0.10
hind leg ♂	0.45	0.32	0.36	0.14	0.10	hind leg ♂	0.90	1.00	0.40	0.29 0.10
fore leg ♀	0.26	0.26				fore leg ♀	0.91	0.72	0.27	0.09
middle leg ♀	0.70	0.22	0.35		0.22	middle leg ♀	0.85	0.64	0.27	0.09
hind leg ♀	0.44	0.35	0.38	0.16	0.12	hind leg ♀	0.91	0.99	0.37	0.26 0.10
<i>Micronecta skutalis</i>						<i>Anisops rhomboides</i>				
fore leg ♂	0.31	0.15	0.21			fore leg ♂	0.97	1.09	0.70	0.21
middle leg ♂	0.53	0.19	0.26		0.19	middle leg ♂	1.44	1.14	0.54	0.35 0.21
hind leg ♂	0.32	0.28	0.25	0.12	0.09	hind leg ♂	2.10	1.74	0.63	0.66 0.08
fore leg ♀	0.32	0.32				fore leg ♀	0.90	1.08	0.46	0.30 0.15
middle leg ♀	0.50	0.18	0.26		0.15	middle leg ♀	1.52	1.19	0.54	0.34 0.20
hind leg ♀	0.33	0.29	0.27	0.12	0.09	hind leg ♀	2.08	1.76	0.68	0.73 0.10
<i>Helotrepes otoeis</i>						<i>Anisops salibabu</i>				
fore leg ♂	0.83	0.80	0.26		0.10	fore leg ♂	0.75	0.98	0.68	0.24
middle leg ♂	0.80	0.60	0.26		0.10	middle leg ♂	1.22	1.02	0.48	0.31 0.17
hind leg ♂	0.78	0.80	0.24	0.26	0.10	hind leg ♂	1.92	1.59	0.60	0.50 0.15
fore leg ♀	0.83	0.65	0.25		0.10	fore leg ♀	0.83	0.99	0.44	0.28 0.18
middle leg ♀	0.80	0.58	0.25		0.08	middle leg ♀	1.29	1.05	0.54	0.33 0.17
hind leg ♀	0.77	0.80	0.24	0.26	0.11	hind leg ♀	2.08	1.71	0.64	0.62 0.13
<i>Hydrotrepes makros</i> (1♂ 1♀ only)										
fore leg ♂	1.17	1.12	0.40		0.10					
middle leg ♂	1.15	0.94	0.40		0.12					
hind leg ♂	1.11	1.37	0.42	0.40	0.16					
fore leg ♀	1.13	0.92	0.36		0.11					
middle leg ♀	1.18	0.80	0.35		0.10					
hind leg ♀	1.12	1.39	0.42	0.40	0.13					
<i>Hydrotrepes mexon</i> (based on 4♂ 2♀) <sup>1</sup>										
fore leg ♂	1.26	1.13	0.37		0.09					
middle leg ♂	1.26	1.02	0.40		0.10					
hind leg ♂	1.36	1.44	0.50	0.41	0.13					
fore leg ♀	1.20	1.05	0.37		0.11					
middle leg ♀	1.21	0.90	0.39		0.11					
hind leg ♀	1.33	1.43	0.50	0.40	0.13					
<i>Hydrotrepes pardalos</i>										
fore leg ♂	0.81	0.74	0.24		0.07					
middle leg ♂	0.77	0.59	0.25		0.09					
hind leg ♂	0.79	0.87	0.30	0.27	0.10					
fore leg ♀	0.79	0.63	0.24		0.08					
middle leg ♀	0.75	0.55	0.25		0.08					
hind leg ♀	0.79	0.90	0.31	0.27	0.10					

<sup>1</sup> in *Micronecta* females tibia+tarsus<sup>2</sup> in *Ochterus* tarsal segment 1 is measured with 2 together, the hind leg has 3 tarsal segments. As there seems to be no systematic difference between the leg measurements in males and females, they have been lumped in *O. pardalos*.

## BOOK REVIEWS

M. Hansen, 1998. *Hydraenidae (Coleoptera) – World Catalogue of Insects 1: 1-168, 1 fig.* Apollo Books, Stenstrup, Denmark. [ISSN 1398-8700, ISBN 87-88757-27-7] Hardback. Price DKK 290.

Making systematic catalogues is a basic and characteristic activity within entomology. In the huge order Coleoptera this culminated in what must be one of the largest catalogues in the world: *Coleopterorum Catalogus*. Almost 24.000 pages were published between 1909 and 1940. Although some supplement volumes of this catalogue were published, recent overviews on a worldscale are lacking for most beetle groups. If such an overview is needed, as is certainly the case in the *Hydraenidae*, a tedious task is waiting; the data from the '*Coleopterorum Catalogus*' have to be updated with the relevant information from decennia of the *Zoological Record*. Many specialists have gone through this lengthy process, at first writing cards, later on using computerdatabases. Making the results of such tedious work publicly available, usually without any personal profits, cannot be praised enough.

The Danish publisher Apollo Books has started a new series with the title '*World Catalogue of Insects*'. This title seems somewhat overambitious, but unlike his famous predecessor Junk, Apollo books does not indicate they are aiming for the immense task of completing such a series.

The first volume of '*World Catalogue of Insects*' is an annotated catalogue of the *Hydraenidae* by Michael Hansen. This catalogue comprising all extant taxa with synonyms and distributional data will be very useful for everybody who is interested in *Hydraenidae* from an area for which no recent faunistic work is available. Special attention has been paid to compile critical distribution data; unreliable older references have been omitted while extensive references for recent work are provided. The catalogue ends with 25 pages of literature references, which is a valuable source of the information. Specialists will be pleased to have all data about type localities and type designations neatly arranged. The last complete world catalogue of *Hydraenidae* was published by Knisch in 1924 in which approximately 300 species were listed. A new catalogue was long overdue as the work of Hansen includes now more than 1150 species.

I consider this and forthcoming catalogues as very valuable publications. Many people however, including myself, would also appreciate to have it available as

a datafile. Production of an accompanying CD-ROM should not be very difficult. Because CD-ROMs are easily copied, distributing data on CD-ROM may constitute a commercial risk. Nevertheless, I expect that seriously interested individuals also want to have a hardcopy at hand. In the mean time one may only hope that the authors will deposit their electronic data in a safe place. It would certainly make the task for future compilers much easier.

The price of this book is very reasonable for the quality offered. I can therefore warmly recommend this book for all persons interested in water beetles.

[J. H. Huijbregts]

Ole Fogh Nielsen, 1998. *De danske guldsmede [The Dragonflies of Denmark]*. – *Danmarks Dyreliv*, 8: 1-280, 233 colour photographs, 258 line drawings, many maps. – Apollo Books, Stenstrup, hardback. [ISBN 87-88757-21-8]. Price DKK 300.

Dragonflies have become very popular in recent years, and hence many beautiful books appear, especially in Europe. The present book, a review of the 53 Danish species, written entirely in Danish, is one of these. A recent addition, *Sympetrum fonscolombei*, is treated in an appendix.

For each species the text provides an introduction, and paragraphs on morphology ('udseende'), habitats ('levested'), behaviour ('adfærd'), life history ('livscyklus'), flying period ('flyvetid') and distribution ('udbredelse'). The species are richly illustrated with colour-photographs of males ('han'), females ('hun'), some larvae and habitats. The quality of photographs and printing is very good indeed. The distribution is shown as shaded areas for the region of Denmark, northern Germany and Poland and southern Norway and Sweden. Apparently this is not based on a recent mapping scheme as is the case in many other European dragonfly-books. At the end of the book, there are keys for adults and larvae.

The scientific contents of the book are somewhat disappointing, the lack of detailed recording and analysis of distributional trends is apparent, as is the very short list of references (one and a half page). Also the author hardly tries to compare the recent changes in the dragonfly fauna to developments in other European countries. The book mostly serves as a narrative of the Danish species and their biotopes. The book is worth its price, though, because of the high quality photographs.

[E.J. van Nieuwerkerken]

# CATALOGUE OF THE ORIENTAL ACENTROPINAE (LEPIDOPTERA, CRAMBIDAE)

Speidel, W. & W. Mey, 1999. Catalogue of the Oriental Acentropinae (Lepidoptera, Crambidae). – Tijdschrift voor Entomologie 142: 125-142, figs. 1-3. [ISSN 0040-7496]. Published 22 September 1999.

The catalogue contains all taxa of Acentropinae (= Nymphulinae) described from the Oriental Region with the references for every taxon. There are many new generic combinations for which the catalogue should be consulted.

New synonyms: *Neoschoenobia decoloralis* Hampson, 1919 is a new junior synonym of *Neoschoenobia testacealis* Hampson, 1900; *Cataclysta dohrni* Hering, 1903 and *Ephormotris octopis* Meyrick, 1933 are new junior synonyms of *Ephormotris dilucidalis* Guérin-Méneville, [1832] 1829-1858 (*Botys*) comb. n. *Oligostigma tripunctalis* Snellen, 1876 is a junior primary homonym of *Oligostigma tripunctalis* Walker, [1866] 1865. This and the replacement name *Aulacodes klimai* Bryk, 1937 are new junior synonyms of *Eoophyla parapomasalis* Hampson, 1897 (*Aulacodes*) comb. n.; *Oligostigma auropunctalis* var. *javanica* Strand, 1914 is a new junior synonym of *Eoophyla excisalis* Snellen, 1901 (*Oligostigma*) comb. n.; *Oligostigma hapilistale* Strand, 1919 is a new junior synonym of *Strepsinoma croesusalis* Walker, 1859 (*Cataclysta*); *Stenicula* Snellen, 1901 and *Micromania* Swinhoe, 1894 (junior homonym of *Micromania* Christoph, 1893) are provisionally treated as new junior synonyms of *Paracymoriza* Warren, 1890; *Paraponyx* [sic] *rugosalis* Möschler, 1890 is a new junior synonym of *Paraponyx fluctuosalis* Zeller, 1852 (*Nymphula*).

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Key-words. – Pyraloidea; Crambidae; Acentropinae; Nymphulinae; catalogue; Oriental region

The Acentropinae belong to the pyraloid family Crambidae. This is a large family with numerous species. Several monophyletic groups have been established within the Crambidae (Minet 1981) which are traditionally treated as subfamilies. The Acentropinae seem to be most closely related to the Schoenobiinae (Yoshiyasu 1985, Passoa 1988). So far 183 described species of Acentropinae are known from the Oriental Region. More species are recorded from the Neotropical Region which is apparently the richest biogeographical region with 247 named species (Munroe in Heppner 1995). Most species of Acentropinae have aquatic larvae. Only a very few species are known to have terrestrial larval instars (e.g. *Nymphicula*). The monophyly of the subfamily has been established by larval and pupal characters: The setae S1 to S3 of the larval head are in a line (Passoa 1988) and the stigmata of abdominal segments 2 to 4 of the pupa are raised and chimney-like (Speidel 1981, Passoa 1988).

The high biodiversity, especially in the tropics, consequently necessitates the production of checklists

or catalogues. Checklists provide a synopsis of the species occurring in a certain region and give the current state of knowledge including the results of modern taxonomic work. Secondly, a checklist is a necessary step in consolidating previous knowledge in order to allow research on the taxonomic group in question. It is a prerequisite to all future revisions. Lists of Lepidoptera including the Acentropinae have been available only for more limited geographical areas of the Oriental Region, e.g. Taiwan (Heppner & Inoue 1992), Thailand (Yoshiyasu 1987) and Nepal (Robinson et al. 1995).

This is the first modern checklist of all Acentropinae known to occur in the Oriental Biogeographical Region as a whole.

The geographical range adopted for the Oriental Region is shown in the map (fig. 1). In the Southeast, the boundaries are between Sulawesi and the Moluccas, and between Sumbawa and Flores. In the West, the region extends along the southern slopes of the Himalayas and Karakorum as far as Nuristan in Af-

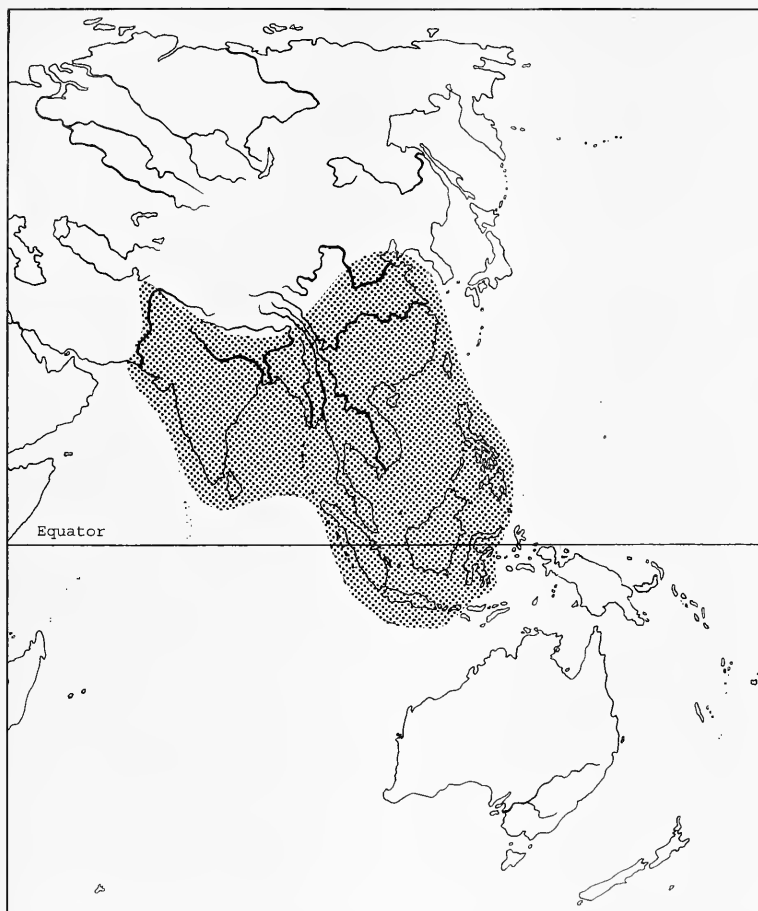


Fig. 1. Range of the Oriental biogeographical region as adopted in the present catalogue.

ghanistan. China is almost completely included, except for the northernmost provinces from Xinjiang to Heilongjiang. The inclusion of the major part of China means that some palearctic species are listed here. However, the distribution of all acentropine species in China is very poorly known. It is quite possible that these palearctic species will turn out to be widely distributed in adjacent parts of the Oriental Region.

#### Nymphulinae versus Acentropinae

In the past, the subfamily was generally known as Nymphulinae or Hydrocampinae and the Acentropinae were treated as a separate subfamily with only one species, *Acentria ephemerella* [Denis & Schiffermüller], 1775. Recently, the subfamilies Acentropinae and Nymphulinae were synonymised and the

priority of Acentropinae was stated (Speidel 1981). Several authors do not accept the name Acentropinae, because Nymphulinae has been in general use for the aquatic moths. However, we cannot suppress the senior name Acentropinae, as the synonymy is a subjective one based on a phylogenetic hypothesis. The revalidation of Nymphulinae would be possible, if new evidence is forwarded to show that *Acentria* represents the most basal clade within the subfamily as currently defined. However, *Acentria* seems to be a highly specialized offshoot of younger clades of the subfamily (Speidel 1998). In our opinion, the present state of knowledge does not justify a change in the priority of these family group names which were both in use before their synonymisation. In an application to the ICZN, published while the present paper was in press, the commission was asked to give precedence to

the family-group name Nymphulinae in the case that Nymphulinae and Acentropinae are regarded as synonyms (Solis 1999). We do not agree with this proposal and regard the application as unnecessary. A more detailed comment to this case is in preparation.

#### MATERIAL AND METHODS

All acenropine taxa of the species-group are listed in the present catalogue. The abbreviations for the references are those used in the 'World List of Scientific Periodicals (Edn 4)' and in 'The Generic Names of Moths of the World' (e. g. Fletcher & Nye 1984). In addition, the full title of every quotation can be found in our references. The type species is cited for all taxa of the genus-group. The original combination and type locality is provided for every taxon of the species-group. It is always indicated when the type locality has been restricted by the selection of a lectotype. The citation of the localities of the paralectotypes may be regarded as redundant. The type localities are cited in the spelling given in the original description. This catalogue is predominantly a compilation from published data in the literature which has been studied in detail. In addition, important new information has been gathered by the study of type specimens during visits to different European museums or by loan of material (The Natural History Museum, London, U. K., Nationaal Natuurhistorisch Museum Naturalis (formerly Rijksmuseum van Natuurlijke Historie), Leiden, Netherlands, Muzeul de Istorie Naturala 'Grigore Antipa', Bukarest, Romania, Laboratory of Entomology, Faculty of Agriculture, Kyoto Prefectural University, Japan). The catalogue is also based on the identified material of several expeditions, especially on the material in the Museum für Naturkunde in Berlin, Germany (including many types). The nomenclature used in the present catalogue follows the rules of the International Code of Zoological Nomenclature in the third edition (February 1985).

The original genus is always given and the authors in changed combinations are placed in parentheses. Unavailable names are marked with an asterisk \*.

#### ACKNOWLEDGEMENTS

We are grateful to the Deutsche Forschungsgemeinschaft for supporting our research in South East Asia (project number Me 1085/5-1). Dr David Agassiz (Gravesend), Michael Shaffer (London) and Shen-Horn Yen (Chung-Ho City, Taipei Hsien) gave valuable comments to an earlier version of the manuscript. The help of our colleague Matthias Nuss (Berlin) is greatly appreciated. Dr Jason Dunlop (Berlin) kindly corrected the English text.

#### CATALOGUE

##### Acentropinae Stephens, [1836] 1835

Aquaticae Hübner, 1796, Samml. europ. Schmett., Pyr.: 18  
Note: This name is not based on an existing genus-group-name

Acentropidae Stephens, [1836] 1835, Illustr. Br. Ent. (Mandibulata) 6: 148

Nymphulites Duponchel, [1845] 1844, Cat. méth. Lépid. Eur.: 201

Hydrocampidae Guenée, 1854, Hist. nat. Insectes (Spec. gén. Lépid.) 8: 254

Acentridae Speyer, 1869, Stettin. ent. Ztg 30: 406

\*Acentropodidae Dunning, 1872, Trans. ent. Soc. Lond. 1872: 152 [invalid emendation]

? Lathrotelidae Clarke, 1971, Smithson. Contr. Zool. 56: 58

##### Neoschoenobia Hampson, 1900

Neoschoenobia Hampson, 1900, Trans. ent. Soc. Lond. 1900: 374. Type species: *Neoschoenobia testacealis* Hampson, 1900 by monotypy

Note: The Australian genus *Eranistis* Meyrick, 1910 seems to be close.

*Neoschoenobia testacealis* Hampson, 1900 (*Neoschoenobia*)  
Trans. ent. Soc. Lond. 1900: 374

Type locality: [RUSSIA] Amurland, Radeffka  
*decoloralis* Hampson, 1919 (*Neoschoenobia*) syn. n.

Type locality: [CHINA] Peking, Western Hills

##### Nymphicula Snellen, [1880]

*Nymphicula* Snellen, [1880] [in Veth, 1880-1892], Mid-den-Sumatra 4 (8): 78. Type species: *Nymphicula stipalis* Snellen, [1880] 1892 by monotypy

*Nymphicula patnalis* (Felder & Rogenhofer, 1874) (*Cataclysta*)

Reise öst. Fregatte Novara (Zool.) 2 (Abt. 2): pl. 136, fig. 7  
Type locality: [INDIA] Calcutta [lectotype]; [INDONESIA] Amboina

Note: The specimen figured in the original description was treated as the 'holotype' by Speidel, 1984, Neue ent. Nachr. 12: 30. This is here accepted as a lectotype-selection.

*Nymphicula bombayensis* (Swinhoe & Cores, 1889) [in Cotes & Swinhoe, 1889] (*Cataclysta*)

Cat. Moths India 5: 651

Type locality: [INDIA] Bombay

*Nymphicula juncialis* (Hampson, 1891) (*Cataclysta*)

Ill. typ. sp. Lep. Het. Brit. Mus. 8: 41, 140, pl. 155, fig. 24  
Type locality: [INDIA] Nilgiri District, W. slopes, 3000 feet.

*Nymphicula mesorhpha* (Meyrick, 1894) (*Cataclysta*)

Trans. ent. Soc. Lond. 1894: 10

Type locality: [MYANMAR] Koni (Upper Burma)

*minuta* Yoshiyasu, 1980 (*Nymphicula*)

Tyo to Ga. Butterfl. Moths 31: 5 (key), 21

Type locality: [JAPAN] Amami-Oshima (Amami Is.)

*Nymphicula albibasalis* Yoshiyasu, 1980 (*Nymphicula*)

Tyo to Ga. Butterfl. Moths 31: 5 (key), 18

Type locality: [JAPAN] Naidaijin, Kumamoto Pref.

(Kyushu)

Note: The species is also recorded from China, Fujian (Speidel, 1984, Neue ent. Nachr. 12: 31).

*Nymphicula xanthobathra* (Meyrick, 1894) (*Anydraula*)  
Trans. ent. Soc. Lond. 1894: 474  
Type locality: [INDONESIA] Pulo Laut

*Nymphicula tripunctata* Yoshiyasu, 1987 (*Nymphicula*)  
Microlep. Thai. 1: 177  
Type locality: [THAILAND] Sai Yok, Kanchanaburi

*Nymphicula stipalis* Snellen, [1880] [in Veth, 1880-1892] (*Nymphicula*)  
Midden-Sumatra 4 (8): 78, pl. 5, fig. 11, 11 a  
Type locality: [INDONESIA] Maros (S. Celebes) [lecto-type]; Silago (Sumatra); Java  
Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 85).

*Nymphicula blandialis* (Walker, 1859) (*Cataclysta*)  
List spec. lep. Ins. Brit. Mus. 17: 448  
Type locality: [SRI LANKA] Ceylon  
*cuneifera* (Moore, [1885] 1884-7) (*Cataclysta*)  
Lepid. Ceylon 3: 300, pl. 179, fig. 14  
Type locality: [SRI LANKA] Ceylon

*Nymphicula nigritalis* (Hampson, 1893) (*Cataclysta*)  
Ill. typ. sp. Lep. Het. Brit. Mus. 9: 52, 178, pl. 174, fig. 5  
Type locality: [SRI LANKA] Pundaloya (Ceylon)

*Nymphicula drusiusalis* (Walker, 1859) (*Cataclysta*)  
List spec. lep. Ins. Brit. Mus. 17: 450  
Type locality: [MALAYSIA] Sarawak, Borneo

*Nymphicula trimacula* (Hampson, 1891) (*Cataclysta*)  
Ill. typ. sp. Lep. Het. Brit. Mus. 8: 40, 139, pl. 155, fig. 14  
Type locality: [INDIA] Nilgiri District, W. slopes, 3000 feet.

*Nymphicula luzonensis* Yoshiyasu, 1997 (*Nymphicula*)  
Esakia 37: 168  
Type locality: [PHILIPPINES] Mt. Maquilin, Los Banos, Luzon.

*Nymphicula meyi* Speidel, 1998 (*Nymphicula*)  
Esperiana 6: 536, pl. U, fig. 2  
Type locality: [PHILIPPINES] Mindanao, Mt. Agtuaganon, 1050 m

*Nymphicula nigrolunalis* Speidel, 1998 (*Nymphicula*)  
Esperiana 6: 537, pl. U, fig. 3  
Type locality: [PHILIPPINES] Leyte, Baybay, VISCA

*Nymphicula infuscatalis* Snellen, 1880 (*Nymphicula*)  
Tijdschr. Ent. 23: 246; Tijdschr. Ent. 27: 51, pl. 5, fig. 6  
Type locality: [INDONESIA] Saleyer (Celebes)

*Nymphicula albidorsalis* Speidel, 1998 (*Nymphicula*)  
Esperiana 6: 537, pl. U, fig. 4  
Type locality: [PHILIPPINES] Samar, Loquilocon, Ulut River, 80 m

*Nymphicula atriterminalis* (Hampson, 1917) (*Cataclysta*)  
Ann. Mag. nat. Hist. (8) 19: 458  
Type locality: [INDONESIA] Saugir I. [Sangihe] (Celebes)



Fig. 2. *Eoophyla* sp., resting position of a male, Cadac-an, Samar, Philippines, April 1997 (Photo: W. Mey).

*Nymphicula acuminatalis* Snellen, 1880 (*Nymphicula*)  
Tijdschr. Ent. 23: 246; Tijdschr. Ent. 27: 51, pl. 5, fig. 7  
Type locality: [INDONESIA] Makassar [Ujung Pandang] (Celebes)

*Nymphicula manilensis* Sauber, 1902 [in Semper 1896-1902] (*Nymphicula*)  
Schmett. Philipp. Ins. 2: 654  
Type locality: [PHILIPPINES] Luzon

*Nymphicula morimotoi* Yoshiyasu, 1997 (*Nymphicula*)  
Esakia 37: 164  
Type locality: [PHILIPPINES] Mt. Maquilin, Los Banos, Luzon.

*Nymphicula eberti* Speidel, 1998 (*Nymphicula*)  
Esperiana 6: 539, pl. U, fig. 6  
Type locality: [PHILIPPINES] Samar, San Mateo, Borongan, 40 m

### *Ephormotris* Meyrick, 1933

*Ephormotris* Meyrick, 1933, Exot. Microlepid. 4: 393. Type species: *Ephormotris octopis* Meyrick, 1933 by monotypy

*Ephormotris dilucidalis* (Guérin-Méneville, [1832] 1829-1858) (*Boys*) comb. n.  
Icon. Règne Animal Cuvier, Insectes: 524, pl. 90, fig. 7  
Type locality: [INDONESIA] Java  
*dohrni* Hering, 1903 (*Cataclysta*) syn. n.  
Stettin. ent. Ztg 64: 51, pl. 1, fig. 30  
Type locality: [INDONESIA] Sumatra  
*octopis* Meyrick, 1933 (*Ephormotris*) syn. n.  
Exot. Microlepid. 4: 393  
Type locality: [MALAYSIA] Kuala Lumpur (Malaya)

*Ephormotris catachystalis* (Hampson, 1897) (*Ambia*) comb. n.  
Trans. ent. Soc. Lond. 1897: 166  
Type locality: [INDONESIA] Pulo Laut

*malayalis* Hampson, 1906 (*Argyractis*)  
Ann. Mag. nat. Hist. (7) 18: 375  
Type locality: [MALAYSIA] Kuala Lumpur (Selangor)

### ***Eoophyla* Swinhoe, 1900**

*Eoophyla* Swinhoe, 1900, Cat. east. and Aust. Lepid. Heterocera Colln Oxf. Univ. Mus. 2: 442. Type species: *Catachysta peribocalis* Walker, 1859 by subsequent designation by Shibuya, 1928, J. Fac. Agric. Hokkaido imp. Univ. 22: 152

*Theila* Swinhoe, 1900, Cat. east. and Aust. Lepid. Heterocera Colln Oxf. Univ. Mus. 2: 443. Type species: *Oligostigma plicatalis* Walker, [1866] 1865 by original designation

### ***crassicornalis* group of species**

*Eoophyla crassicornalis* (Guenée, 1854) (*Oligostigma*)

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 261

Type locality: [INDONESIA] Java

*javanalis* Guenée, 1854 (*Oligostigma*)

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 262

Type locality: [INDONESIA] Java

*Eoophyla bipunctalis* (Walker, [1866] 1865) (*Oligostigma*)

List spec. lep. Ins. Brit. Mus. 34: 1531

Type locality: [INDONESIA] Java

*Eoophyla latifascialis* (Snellen, 1876) (*Oligostigma*)

Tijdschr. Ent. 19: 194 (key), 202, pl. 8, fig. 7 a, b

Type locality: [INDONESIA] Bonthain (Celebes)

*Eoophyla adjunctalis* (Snellen, 1895) (*Oligostigma*)

Tijdschr. Ent. 38: 158, pl. 6, fig. 17, 18

Type locality: [INDONESIA] Tegal, Kemanglen (Central Java) [lectotype]

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 67).

*Eoophyla mindanensis* Speidel, 1998 (*Eoophyla*)

Nachr. ent. Ver. Apollo, Suppl. 17: 469

Type locality: [PHILIPPINES] Mindanao, Mt. Agtuuganon, 1050 m

*Eoophyla colonialis* (Guenée, 1854) (*Oligostigma*)

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 262

Type locality: [INDIA] Bombay

*Eoophyla aureolalis* (Snellen, 1876) (*Oligostigma*)

Tijdschr. Ent. 19: 193 (key), 200, pl. 8, fig. 5 a-c

Type locality: [INDONESIA] Java; Ardoeno (Java)

*Eoophyla philippinensis* Speidel, 1998 (*Eoophyla*)

Nachr. ent. Ver. Apollo, Suppl. 17: 470

Type locality: [PHILIPPINES] Mindanao, Davao oriental, NO Boston, Caatjaan

*Eoophyla polydora* (Meyrick, 1897) (*Oligostigma*)

Trans. ent. Soc. Lond. 1897: 82

Type locality: [INDONESIA] Sangir

### ***peribocalis* group of species**

*Eoophyla halialis* (Walker, 1859) (*Catachysta*)

List spec. lep. Ins. Brit. Mus. 17: 447

Type locality: China

*sabrina* Pryer, 1877 (*Catachysta*)

Cistula ent. 2: 232, pl. 4, fig. 3

Type locality: [CHINA] Snowy Valley (Chekiang Province)

*Eoophyla sejunctalis* (Snellen, 1876) (*Oligostigma*)

Tijdschr. Ent. 19: 196 (key), 207, pl. 9, fig. 11 a-c

Type locality: [INDIA] Dharmasala

*delicata* Moore, [1887] 1884-7 (*Catachysta*)

Lepid. Ceylon 3: 556, pl. 215, fig. 5

Type locality: [SRI LANKA] Ceylon

*Eoophyla peribocalis* (Walker, 1859) (*Catachysta*)

List spec. lep. Ins. Brit. Mus. 17: 446

Type locality: [INDIA] Hindostan

*papulalis* Snellen, 1890 (*Oligostigma*)

Trans. ent. Soc. Lond. 1890: 640

Type locality: [INDIA] Sikkim

*Eoophyla dominalis* (Walker, [1866] 1865) (*Catachysta*)  
**comb. n.**

List spec. lep. Ins. Brit. Mus. 34: 1337

Type locality: [INDIA] South Hindostan

*Eoophyla melanops* (Hampson, 1896) (*Aulacodes*)

Fauna Br. India (Moths) 4: 214

Type locality: [INDIA] Sikhim [sic]

*Eoophyla thaiensis* Yoshiyasu, 1987 (*Eoophyla*)

Microlep. Thai. 1: 164

Type locality: [THAILAND] Nam Tok Lam Pee, Phangnga

*Eoophyla conjunctalis* (Wileman & South, 1917) (*Aulacodes*)

Entomologist 50: 176

Type locality: [TAIWAN] Formosa

*aulacodealis* Strand, 1919 (*Oligostigma*)

Ent. Mitt. 8: 106

Type locality: [TAIWAN] Kosempo; Alikang (Formosa)

*Eoophyla inoueii* Yoshiyasu, 1979 (*Eoophyla*)

Akitsu (n. s.) 22: 1

Type locality: [JAPAN] Omoto (Miyara River), Ishigaki I., Ryukyus

*Eoophyla nectalis* (Snellen, 1876) (*Oligostigma*)

Tijdschr. Ent. 19: 195 (key), 206, pl. 9, fig. 10

Type locality: [INDONESIA] Java

*Eoophyla ectopalis* (Hampson, 1906) (*Parthenodes*)

Ann. Mag. nat. Hist. (7) 18: 472

Type locality: [MALAYSIA] Mt. Mulu (N. Borneo)

*Eoophyla snelleni* Semper, 1902, 1896-1902 (*Eoophyla* [sic])

Schmett. Philipp. Ins. 2: 656, pl. 66, fig. 4, 5

Type locality: [PHILIPPINES] Luzon, Mindanao, Camiguin de Mindanao

*splendens* West, 1931 (*Aulacodes*)

Novit. zool. 36: 214

Type locality: [PHILIPPINES] Klondyke, 800 feet (Benguet, Luzon)

*Eoophyla mormodes* (Meyrick, 1897) (*Oligostigma*)

Trans. ent. Soc. Lond. 1897: 83

Type locality: [INDONESIA] Sangir

*gibbosalis* group of species

*Eoophyla gibbosalis* (Guenée, 1854) (*Oligostigma*)

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 262

Type locality: Indes orientales

*plicatilis* Walker, [1866] 1865 (*Oligostigma*)

List spec. lep. Ins. Brit. Mus. 34: 1332

Type locality: [INDONESIA] Makian, Celebes

*tripunctalis* Walker, [1866] 1865 (*Oligostigma*)

List spec. lep. Ins. Brit. Mus. 34: 1531

Type locality: [INDONESIA] Java

*Eoophyla hirsuta* (Semper, 1902, 1896-1902) (*Theila*)

Schmett. Philipp. Ins. 2: 657, pl. 66, fig. 6

Type locality: [PHILIPPINES] Luzon, Bohol

*Eoophyla parapomasalis* (Hampson, 1897) (*Aulacodes*) **comb. n.**

Trans. ent. Soc. Lond. 1897: 175

Type locality: [INDONESIA] Alor, Flores

\**tripunctalis* Snellen, 1876 (*Oligostigma*) **syn. n.**

Tijdschr. Ent. 19: 195 (key), 205, pl. 9, fig. 9 a, b

Type locality: [INDONESIA] Malang [lectotype]; Ardjoeno (Java)

Note: *Oligostigma tripunctalis* Snellen, 1876 is a junior primary homonym of *Oligostigma tripunctalis* Walker, [1866] 1865. The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 86).

*klimai* Bryk, 1937 [in Klima 1937, in Bryk 1937] (*Aulacodes*) **syn. n.**

Lepid. Cat. (84): 141 (replacement-name for *tripunctalis*)

*Eoophyla sinensis* (Hampson, 1897) (*Aulacodes*)

Trans. ent. Soc. Lond. 1897: 176

Type locality: [CHINA] Omei Shan [Emei Shan] (W. China)

*Eoophyla hamalis* (Snellen, 1876) (*Oligostigma*)

Tijdschr. Ent. 19: 192 (key), 199, pl. 8, fig. 4 a-c

Type locality: [INDIA] Dharmasala

*Eoophyla ochripicta* (Moore, 1888) [in Hewitson & Moore, 1879-88] (*Catachysta*)

Descr. lepid. Insects Colln late Mr W. S. Atkinson (3): 209

Type locality: [INDIA] Cherra Punji

*Eoophyla saturatalis* (Snellen, 1890) (*Oligostigma*) **comb. n.**

Trans. ent. Soc. Lond. 1890: 639

Type locality: [INDIA] Sikkim

*Eoophyla simplicialis* (Snellen, 1876) (*Oligostigma*)

*Eoophyla simplicialis simplicialis* (Snellen, 1876) (*Oligostigma*)

Tijdschr. Ent. 19: 193 (key), 201, pl. 8, fig. 6

Type locality: [INDONESIA] Java [lectotype: Buitenzorg]

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 84).

*Eoophyla simplicialis rufalis* (Caradja, 1938) (*Oligostigma simplicialis* f.)

Stettin. ent. Ztg 99: 256

Type locality: [CHINA] Schaowa [Shaowu, Fukien]

*Eoophyla mimeticalis* (Caradja, 1925) (*Aulacodes*) **comb. n.**

Memle Sect. Stiint. Acad. rom. (3) 3 (7): 332, pl. 1, fig. 34

Type locality: [CHINA] Amoy, Canton

other groups of species

*Eoophyla nigripilosa* Yoshiyasu, 1987 (*Eoophyla*)

Microlep. Thai. 1: 170

Type locality: [THAILAND] Wang Ta Krai, Nakhon Nayok

*Eoophyla ceratucha* (Meyrick, 1894) (*Oligostigma*)

Trans. ent. Soc. Lond. 1894: 471

Type locality: [INDONESIA] Pulo Laut

*falcatalis* Snellen, 1901 (*Oligostigma*)

Tijdschr. Ent. 43: 287, pl. 16, fig. 7, 8

Type locality: [INDONESIA] Buitenzorg [lectotype] (West-Java); Sumatra

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 74).

*Eoophyla hemimelaena* (Hampson, 1917) (*Aulacodes*) **comb. n.**

Ann. Mag. nat. Hist. (8) 19: 470

Type locality: [PHILIPPINES] Manila

*Eoophyla hemicyrtis* (Meyrick, 1897) (*Oligostigma*) **comb. n.**

Trans. ent. Soc. Lond. 1897: 84

Type locality: [INDONESIA] Sangir

*Eoophyla angustalis* (Sauber, 1902 [in Semper, 1896-1902]) (*Oligostigma*) **comb. n.**

Schmett. Philipp. Ins. 2: 655

Type locality: [PHILIPPINES] Ost-Mindanao

*Eoophyla simplex* (West, 1931) (*Aulacodes*) **comb. n.**

Novit. zool. 36: 214

Type locality: [PHILIPPINES] Palali, 2000 feet (Benguet, Luzon)

*Eoophyla idiotis* (Meyrick, 1894) (*Oligostigma*) **comb. n.**

Trans. ent. Soc. Lond. 1894: 472

Type locality: [INDONESIA] Celebes

*Eoophyla discalis* (Hampson, 1906) (*Oligostigma*) **comb. n.**

Ann. Mag. nat. Hist. (7) 18: 464

Type locality: [INDONESIA] Bonthain (Celebes)

*Eoophyla metriodora* (Meyrick, 1897) (*Oligostigma*) **comb. n.**

Trans. ent. Soc. Lond. 1897: 83

Type locality: [INDONESIA] Talaut

*quinqualis* group of species

*Eoophyla argyropis* (Meyrick, 1894) (*Oligostigma*) **comb. n.**

Trans. ent. Soc. Lond. 1894: 473

Type locality: [INDONESIA] Celebes

*Eoophyla quinqualis* (Snellen, 1892) (*Oligostigma*) **comb. n.**

Tijdschr. Ent. 35: 176

Type locality: [INDONESIA] Celebes [lectotype Bantimeroeng]; Java

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 82).

\**quinquinalis*, Klima, 1937 [in Bryk, 1937], misspel. (*Oligostigma*)

Lepid. Cat. (84): 119

*Eoophyla basilissa* (Meyrick, 1894) (*Oligostigma*) **comb. n.**

Trans. ent. Soc. Lond. 1894: 474

Type locality: [INDONESIA] Sambawa

*Eoophyla gephyrotis* (Meyrick, 1897) (*Oligostigma*)

Trans. ent. Soc. Lond. 1897: 84

Type locality: [INDONESIA] Talaut

**lobophoralis group of species**

Note: This group is tentatively placed in *Eoophyla*.

*Eoophyla tigrimalis* (Hampson, 1897) (*Ambia*) **comb. n.**

Trans. ent. Soc. Lond. 1897: 165

Type locality: [INDONESIA] Pulo Laut

*Eoophyla lobophoralis* (Hampson, 1896) (*Ambia*) **comb. n.**

Fauna Br. India (Moths) 4: 207

Type locality: [INDIA] Sikhim [sic]; Nagas

*Eoophyla iriusalis* (Walker, 1859) (*Oligostigma*?) **comb. n.**

List spec. lep. Ins. Brit. Mus. 17: 434

Type locality: [MALAYSIA] Sarawak, Borneo

*Eoophyla palleuca* (Hampson, 1906) (*Oligostigma*) **comb. n.**

Ann. Mag. nat. Hist. (7) 18: 465

Type locality: [MALAYSIA] Kina Balu (Borneo)

**Agassiziella Yoshiyasu, 1989**

*Agassiziella* Yoshiyasu, 1989, Microlep. Thai. 2: 169. Type species: *Oligostigma angulipennis* Hampson, 1891 by original designation

\**Agassizia* Yoshiyasu, 1987, Microlep. Thai. 1: 141

*Agassiziella angulipennis* (Hampson, 1891) (*Oligostigma*)

Ill. typ. sp. Lep. Het. Brit. Mus. 8: 40, 139, pl. 155, fig. 6

Type locality: [INDIA] Nilgiri District, W. slopes, 3000 feet.

*Agassiziella picalis* (Guenée, 1854) (*Hydrocampa*)

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 274

Type locality: [INDIA] Inde centrale

*Agassiziella albidivisa* (Warren, 1896) (*Oligostigma*)

Ann. Mag. nat. Hist. (6) 18 (105): 221

Type locality: [INDIA] Khasias

*Agassiziella hapilista* (Swinhoe, 1892) (*Cataglyphis*)

Trans. ent. Soc. Lond. 1892: 20, pl. 1, fig. 11

Type locality: [INDIA] Khasia Hills

*Agassiziella fuscifusalis* (Hampson, 1893) (*Oligostigma fuscifusale*)

Ill. typ. sp. Lep. Het. Brit. Mus. 9: 51, 177, pl. 174, fig. 28

Type locality: [SRI LANKA] Nawala-pittia (Ceylon)

*Agassiziella niveinotatum* (Hampson, 1893) (*Oligostigma*) **comb. n.**

Ill. typ. sp. Lep. Het. Brit. Mus. 9: 51, 176, pl. 174, fig. 32

Type locality: [SRI LANKA] Kelani Valley (Ceylon)

*Agassiziella alicialis* (Hampson, 1906) (*Oligostigma*) **comb. n.**

Ann. Mag. nat. Hist. (7) 18: 463

Type locality: [SRI LANKA] Udagama (Ceylon)

*Agassiziella dianale* (Hampson, 1893) (*Oligostigma*) **comb. n.**

Ill. typ. sp. Lep. Het. Brit. Mus. 9: 51, 177, pl. 174, fig. 27

Type locality: [SRI LANKA] Nawala-pittia (Ceylon)

*Agassiziella kwangtungiale* (Caradja, 1925) (*Oligostigma*) **comb. n.**

Memle Sect. Stint. Acad. rom. (3) 3 (7): 331, pl. 1, fig. 33

Type locality: [CHINA] Kuling, Canton

Note: This species is placed in *Agassiziella* on the advice of S.-H. Yen (personal communication).

**Hemiloba Swinhoe, 1901**

*Hemiloba* Swinhoe, 1901, Ann. Mag. nat. Hist. (7) 8 (43):

24. Type species: *Hemiloba excisa* Swinhoe, 1901 by monotypy

*Hemiloba excisa* Swinhoe, 1901 (*Hemiloba*)

Ann. Mag. nat. Hist. (7) 8 (43): 24

Type locality: [INDIA] Jaintia Hills

**Eristena Warren, 1896**

*Eristena* Warren, 1896, Ann. Mag. nat. Hist. (6) 17 (98):

149. Type species: *Eristena murimalis* Warren, 1896 by original designation

*Eristena bifurcalis* (Pryer, 1877) (*Cataglyphis*)

Cistula ent. 2: 232, pl. 4, fig. 4

Type locality: [CHINA] Snowy Valley (Chekiang Province)

*Eristena bifurcalis szechuanalis* (Caradja, 1934) (*Oligostigma bifurcale* var.)

Ark. Zool. 27 A (8): 7

Type locality: [CHINA] NE. Szechuan, 300 m

*Eristena albifurcalis* (Hampson, 1906) (*Oligostigma*) **comb. n.**

Ann. Mag. nat. Hist. (7) 18: 466

Type locality: [INDIA] Khasis (Assam)

*Eristena chrysozonalis* (Hampson, 1912) (*Oligostigma*) **comb. n.**

J. Bombay nat. Hist. Soc. 21: 1261

Type locality: [INDIA] Palnis (Madras)

*Eristena auropunctalis* (Hampson, 1903) (*Oligostigma*) **comb. n.**

J. Bombay nat. Hist. Soc. 15: 210

Type locality: Bhutan

*Eristena excisalis* (Snellen, 1901) (*Oligostigma*) **comb. n.**

Tijdschr. Ent. 43: 289, pl. 16, fig. 9

Type locality: [INDONESIA] Buitenzorg (West-Java)

*javanica* Strand, 1914 (*Oligostigma auropunctalis* var.) **syn. n.**

Ent. Mitt. 3: 276

Type locality: [INDONESIA] Java

*Eristena ornata* (Moore, [1885] 1884-7) (*Cataglyphis*) **comb. n.**

Lepid. Ceylon 3: 299, pl. 181, fig. 11

Type locality: [SRI LANKA] Ceylon

*Eristena fulva* Yoshiyasu, 1987 (*Eristena*)

Microlep. Thai. 1: 156

Type locality: [THAILAND] Mae-Sa, Chiang Mai

*Eristena argentata* Yoshiyasu, 1988 (*Eristena*)

Kontyu 56: 36

Type locality: [JAPAN] Shinmura, Amami-Oshima, Amami Iss.

*Eristena pumila* Yoshiyasu, 1987 (*Eristena*)  
Microlep. Thai. 1: 158  
Type locality: [THAILAND] Khao Yai, Nakhon Nayok

*Eristena gregaria* Yoshiyasu, 1984 (*Eristena*)  
Tyo to Ga. Butterf. Moths 35: 1  
Type locality: [THAILAND] Fang, Chiang Mai

*Eristena tanongchiti* Yoshiyasu, 1984 (*Eristena*)  
Tyo to Ga. Butterf. Moths 35: 5  
Type locality: [THAILAND] Kaosoi Dao, Chantaburi

*Eristena mangalis* Murphy, 1989 (*Eristena*)  
Raffles Bull. zool. 37 (1 & 2): 144  
Type locality: [SINGAPORE] Mandai magroves

*Eristena postalbalis* (Hampson, 1893) (*Parapoynx*) comb. n.  
Ill. typ. sp. Lep. Het. Brit. Mus. 9: 51, 175, pl. 174, fig. 3  
Type locality: [SRI LANKA] Nawala-pittia (Ceylon)

*Eristena murinalis* Warren, 1896 (*Eristena*)  
Ann. Mag. nat. Hist. (6) 17 (98): 150  
Type locality: [INDIA] Khasias

*Eristena oligostigmalis* Hampson, 1906 (*Eristena*)  
Ann. Mag. nat. Hist. (7) 18: 389  
Type locality: [INDIA] Andamans

*Eristena straminealis* Hampson, 1903 (*Eristena*)  
J. Bombay nat. Hist. Soc. 15: 209  
Type locality: [INDIA] Sikhim [sic], 7000'

*Eristena thalassalis* Murphy, 1989 (*Eristena*)  
Raffles Bull. zool. 37 (1 & 2): 151  
Type locality: [SINGAPORE] Pasir Ris mangroves

*Eristena shafferi* Murphy, 1989 (*Eristena*)  
Raffles Bull. zool. 37 (1 & 2): 155  
Type locality: [SINGAPORE] Mandai magroves

*Eristena araealis* (Hampson, 1897) (*Oligostigma*) comb. n.  
Trans. ent. Soc. Lond. 1897: 170  
Type locality: [SRI LANKA] Kandy, Ceylon

*Eristena orthoteles* (Meyrick, 1894) (*Oligostigma*) comb. n.  
Trans. ent. Soc. Lond. 1894: 472  
Type locality: [INDONESIA] Sambawa

*Eristena campoteles* (Hampson, 1906) (*Oligostigma*) comb. n.  
Ann. Mag. nat. Hist. (7) 18: 464  
Type locality: [INDONESIA] Tambora [Sumbawa]

*Eristena parvalis* (Moore, 1877) (*Oligostigma*) comb. n.  
Proc. zool. Soc. Lond. 1877: 616  
Type locality: [INDIA] Port Blair (S. Andamans)

*Eristena pulchellale* (Hampson, 1893) (*Oligostigma*) comb. n.  
Ill. typ. sp. Lep. Het. Brit. Mus. 9: 52, 178, pl. 174, fig. 30  
Type locality: [SRI LANKA] Nawala-pittia (Ceylon)

*Eristena melanotalis* (Hampson, 1906) (*Oligostigma*) comb. n.  
Ann. Mag. nat. Hist. (7) 18: 463  
Type locality: [SRI LANKA] Pundaloya (Ceylon)

*Eristena endosaris* (Meyrick, 1894) (*Oligostigma*)  
Trans. ent. Soc. Lond. 1894: 472  
Type locality: [INDONESIA] Pulo Laut  
Note: The generic position of this species is preliminary.

*Eristena minutale* (Caradja, 1932) (*Oligostigma*)  
Bull. Sect. Stiint. Acad. rom. 15: 148  
Type locality: [CHINA] Amoy  
Note: The generic position of this species is preliminary.

*Eristena fumibasale* (Hampson, 1896) (*Oligostigma*)  
Fauna Br. India (Moths) 4: 208  
Type locality: [SRI LANKA] Puttalam (Ceylon)  
Note: The generic position of this species is preliminary.

*Eristena syagrusalis* (Walker, 1859) (*Cataglyphis*)  
List spec. lep. Ins. Brit. Mus. 19: 953  
Type locality: [MALAYSIA] Sarawak, Borneo  
*melanodes* Meyrick, 1894 (*Oligostigma*)  
Trans. ent. Soc. Lond. 1894: 473  
Type locality: [INDONESIA] S. E. Borneo  
Note: The generic position of this species is preliminary.

### *Strepsinoma* Meyrick, 1897

*Strepsinoma* Meyrick, 1897, Trans. ent. Soc. Lond. 1897:  
85. Type species: *Strepsinoma amaura* Meyrick, 1897 by  
original designation

*Strepsinoma amaura* Meyrick, 1897 (*Strepsinoma*)  
Trans. ent. Soc. Lond. 1897: 86  
Type locality: [INDONESIA] Sambawa; S. E. Borneo

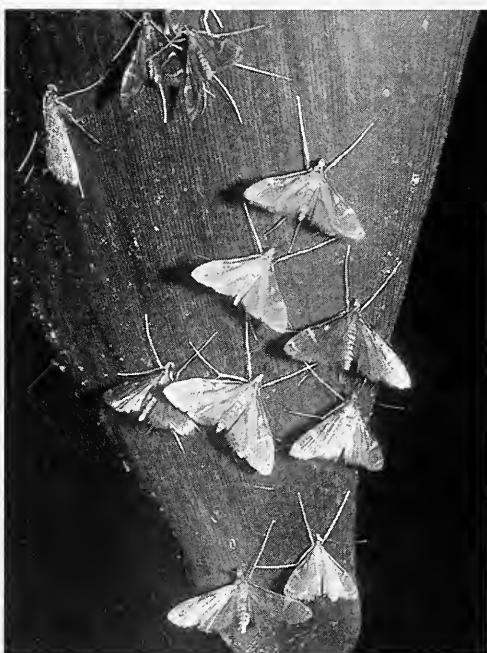


Fig. 3. *Strepsinoma* sp., typical aggregation of specimens on the underside of a leaf hanging over a creek, Patag, Negros, Philippines, May 1996 (Photo: R. Müller).

*Strepsinoma croesusalis* (Walker, 1859) (*Cataclysta*)

*Strepsinoma croesusalis croesusalis* (Walker, 1859) (*Cataclysta*)

List spec. lep. Ins. Brit. Mus. 17: 449

Type locality: [MALAYSIA] Sarawak, Borneo

*trigonalis* Swinhoe, 1895 (*Cataclysta*)

Ann. Mag. nat. Hist. (6) 16: 304

Type locality: [INDIA] Shillong

*bapilistale* (Strand, 1919) (*Oligostigma*?) syn. n.

Ent. Mitt. 8: 105

Type locality: [TAIWAN] Suisharyo (Formosa)

Note: Synonymisation according to S.-H. Yen (personal communication).

*Strepsinoma croesusalis angustalis* (Caradja, 1925) (*Cataclysta croesusalis* ssp.)

Memle Sect. Stiint. Acad. rom. (3) 3 (7): 329

Type locality: [CHINA] Canton

*Strepsinoma sphenactis* Meyrick, 1897 (*Strepsinoma*)

Trans. ent. Soc. Lond. 1897: 86

Type locality: [INDONESIA] Sangir

***Margarosticha* Lederer, 1863**

*Margarosticha* Lederer, 1863, Wien. ent. Monatschr. 7: 267 (key), 454. Type species: *Margarosticha pulcherrimalis* Lederer, 1863 by monotypy

*Margarosticha pulcherrimalis* Lederer, 1863

Wien. ent. Monatschr. 7: 454, pl. 2, fig. 28; pl. 18, fig. 11

Type locality: [INDONESIA] Amboina

Note: The species is widely distributed in the Moluccas. It is recorded in the Oriental Region (as here defined) only from Sumatra (Robinson, Tuck & Shaffer 1994: 167). There is a series (correctly identified) from Sumatra in the Natural History Museum, London, but we have not seen recently collected material from there. The specimens from Sumatra may be mislabeled, but we include the present species in the Oriental List because the labels of these specimens are genuine.

*Margarosticha bimaculalis* Snellen, 1880 (*Margarosticha*)

Tijdschr. Ent. 23: 245; 27: 50, pl. 5, fig. 5, 5 a

Type locality: [INDONESIA] Bonthain [lectotype]; Balangnipa (Celebes)

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 70)

***Potamusa* Yoshiyasu, 1985**

*Potamusa* Yoshiyasu, 1985, Scientific Rep. Kyoto prefect. Univ. (Agric.) 37: 15, 16 (keys), 107. Type species: *Cataclysta midas* Butler, 1881 by original designation

Note: *Potamusa* is very close to the Nearctic genus *Neocataclysta* Lange, 1956

*Potamusa midas* (Butler, 1881) (*Cataclysta*)

Trans. ent. Soc. Lond. 1881: 585

Type locality: [JAPAN] Tokyo [Tokyo]

Note: This species is recorded in China as far South as Hubei (Changyang) (Speidel 1984, Neue ent. Nachr. 12: 41)

***Paracymoriza* Warren, 1890**

*Paracymoriza* Warren, 1890, Ann. Mag. nat. Hist. (6) 6 (36): 479. Type species: *Oligostigma vagalis* Walker, [1866] 1865 by original designation

*Stenicula* Snellen, 1901, Tijdschr. Ent. 43: 284. Type species: *Stenicula flavicaput* Snellen, 1901 by monotypy. Syn. n.

\* *Micromania* Swinhoe, 1894, Ann. Mag. nat. Hist. (6) 14: 141. Syn. n.

Note: The genus is defined here in a very broad sense. Males with modified setae on the apex of the valva. Larvae in stagnant water or terrestrial (S.-H. Yen, personal communication). The larvae are never flattened or adapted to live in fast running water as those of *Eoophyla* and related genera which have similar male genitalia. *Micromania* Swinhoe, 1894 is a junior homonym of *Micromania* Christoph, 1893 (Lepidoptera, Noctuidae). The genus was transferred to the Nymphulinae near *Paracymoriza* by Munroe 1977 (Can. Ent. 109: 1350). Therefore, it is formally treated as a junior synonym of *Paracymoriza* though the type material has not been studied.

***prodigalis* group of species**

Note: This group possibly merits a genus of its own.

*Paracymoriza prodigalis* (Leech, 1889) (*Cataclysta*) comb. n.

Entomologist 22: 70, pl. 4, fig. 16

Type locality: [N. KOREA] Gensan [Wonsan] [lectotype];

[JAPAN] Tsuruga (Honshu)

Note: The lectotype has been selected by Speidel 1984 (Neue ent. Nachr. 12: 94).

*bifurcalis* Wileman, 1911 (*Parthenodes*)

Trans. ent. Soc. Lond. 1911: 373, pl. 31, fig. 23

Type locality: [JAPAN] Komatsu, Iyo (Shikoku)

*Paracymoriza cataclystalis* (Strand, 1919) (*Oligostigma*)

Ent. Mitt. 8: 105

Type locality: [TAIWAN] Suisharyo (Formosa)

Note: Has to be regarded as a separate species according to S.-H. Yen (*in litt.*)

*Paracymoriza yuennanensis* (Caradja, 1937) [in Caradja & Meyrick, 1937] (*Parthenodes prodigalis* ssp.) comb. n.

Dt. ent. Z. Iris 51: 159

Type locality: [CHINA] Yülingshan near Likiang, 2800-3200 m (Yunnan)

*Paracymoriza fuscalis* (Yoshiyasu, 1985) (*Parthenodes*) comb. n.

Scientific Rep. Kyoto prefect. Univ. (Agric.) 37: 97

Type locality: [JAPAN] Mt. Yuwan-dake, Amami-Oshima Is.

*Paracymoriza okinawanus* (Yoshiyasu & Arita, 1992) (*Parthenodes*) comb. n.

Tropical Lepidoptera 3: 131

Type locality: [JAPAN] Yona, Okinawa-jima Id., Ryukyu Is. (Japan)

***laminalis* group of species**

*Paracymoriza laminalis* (Hampson, 1901 [in Leech, 1901]) (*Aulacodes*)

Trans. ent. Soc. Lond. 1901: 437

Type locality: [CHINA] Chang-yang [Changyang, Hubei]; Ichang [Yichang, Hubei]; Kiukiang [Jiujiang, Jiangxi]

*Paracymoriza reductalis* (Caradja, 1925) (*Aulacodes*)  
Memle Sect. Stiint. Acad. rom. (3) 3 (7): 332, pl. 1, fig. 35  
Type locality: [CHINA] Lienping; Canton

**nigra group of species**

*Paracymoriza nigra* (Warren, 1896) (*Nymphula*)  
Ann. Mag. nat. Hist. (6) 18 (105): 220  
Type locality: [INDIA] Khasias

*Paracymoriza latifascialis* (Warren, 1896) (*Nymphula*) **comb. n.**  
Ann. Mag. nat. Hist. (6) 18 (105): 220  
Type locality: [INDIA] Khasias

*Paracymoriza flavicaput* (Snellen, 1901) (*Stenicula*) **comb. n.**  
Tijdschr. Ent. 43: 285, pl. 16, fig. 2, 3  
Type locality: [INDONESIA] Gedeh, 4500 voet (West-Java) [lectotype]; Tengger gebergte, 2100 voet (Oost-Java)  
Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 74).

**distinctalis group of species**

*Paracymoriza bleszynskialis* Roesler & Speidel, 1981 (*Paracymoriza*)  
Articulata 1: 201  
Type locality: [CHINA] Omei, 3500 ft. [Emei shan] (Sichuan)

*Paracymoriza distinctalis* (Leech, 1889) (*Diasemia*)  
Entomologist 22: 67, pl. 4, fig. 5  
Type locality: [CHINA] Snowy Valley, near Ningpo [Ningbo] (Zhejiang)

*triangularis* South, 1901 [in Leech, 1901] (*Parthenodes*)  
Trans. ent. Soc. Lond. 1901: 438, pl. 14, fig. 26  
Type locality: [CHINA] Muping (Sichuan, China)  
*\*triangularis*, Klima, 1937 [in Bryk, 1937], misspel. (*Parthenodes*)  
Lepid. Cat. (84): 124

*Paracymoriza taiwanalis* (Wileman & South, 1917) (*Parthenodes*)  
Entomologist 50: 176  
Type locality: [TAIWAN] Arizan (7300 ft.) (Formosa)

**eromenalis group of species**

*Paracymoriza eromenalis* (Snellen, 1880) (*Coenostola*)  
Tijdschr. Ent. 23: 226; Tijdschr. Ent. 27: 36, pl. 3, fig. 4, 4 a  
Type locality: [INDONESIA] Makassar [Ujung Pandang] (Celebes) [lectotype]  
Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 73).

*Paracymoriza parallela* Sauber, 1902 [in Semper, 1896-1902] (*Paracymoriza*)  
Schmett. Philipp. Ins. 2: 657, pl. 66, fig. 7  
Type locality: [PHILIPPINES] Luzon

**vagalis group of species**

*Paracymoriza vagalis* (Walker, [1866] 1865) (*Oligostigma*)  
List spec. lep. Ins. Brit. Mus. 34: 1530  
Type locality: [INDONESIA] Java  
*exsuhalis* Snellen, [1880] [in Veth, 1880-1892] (*Hydrocampa*)  
Midden-Sumatra 4 (8): 76  
Type locality: [INDONESIA] Alahan pandjang; Moea Laboe (Sumatra) [lectotype: 'Sumatra']; Java

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 74).

*Paracymoriza aurantialis* Swinhoe, 1895 (*Paracymoriza*)  
Ann. Mag. nat. Hist. (6) 16: 304  
Type locality: [INDIA] Cherra Punji

*Paracymoriza olivalis* Hampson, 1891 (*Paracymoriza*)  
Ill. typ. sp. Lep. Het. Brit. Mus. 8: 41, 140, pl. 155, fig. 8  
Type locality: [INDIA] Nilgiri District, N. slopes, 3500 feet

*dentifascialis* Hampson, 1891 (*Paracymoriza*)  
Ill. typ. sp. Lep. Het. Brit. Mus. 8: 41, 141, pl. 155, fig. 21  
Type locality: [INDIA] Nilgiri District, W. slopes, 3000 feet

*Paracymoriza immanis* (Hampson, 1906) (*Parthenodes*) **comb. n.**  
Ann. Mag. nat. Hist. (7) 18: 470  
Type locality: [MALAYSIA] Kina Balu (N. Borneo)

*Paracymoriza inextricata* (Moore, 1888 [in Hewitson & Moore, 1879-88]) (*Cymoriza*)  
Descr. lepid. Insects Colln late Mr W. S. Atkinson (3): 210, pl. 7, fig. 7  
Type locality: [INDIA] Khasia Hills

*Paracymoriza rivularis* (Moore, 1888 [in Hewitson & Moore, 1879-88]) (*Cymoriza*) **comb. n.**  
Descr. lepid. Insects Colln late Mr W. S. Atkinson (3): 210, pl. 7, fig. 8  
Type locality: [INDIA] Darjiling

**albifascialis group of species**

*Paracymoriza albalis* Yoshiyasu, 1987 (*Paracymoriza*)  
Microlep. Thai. 1: 147  
Type locality: [THAILAND] Khao Soi Dao, Chanthaburi

*Paracymoriza albifascialis* Hampson, 1891 (*Paracymoriza*)  
Ill. typ. sp. Lep. Het. Brit. Mus. 8: 41, 140, pl. 156, fig. 1, 9  
Type locality: [INDIA] Nilgiri District, S. slopes, 3000 feet, N. slopes, 3500 feet

*Paracymoriza phlegetonalis* (Snellen, 1895) (*Hydrocampa*) **comb. n.**  
Tijdschr. Ent. 38: 155, pl. 6, fig. 9, 10  
Type locality: [INDONESIA] Buitenzorg (West-Java)  
*semialbida* Warren, 1896 (*Paracymoriza*)  
Ann. Mag. nat. Hist. (6) 17 (99): 203  
Type locality: [INDIA] Khasias

*Paracymoriza stigmatalis* (Swinhoe, 1894) (*Micromania*) **comb. n.**  
Ann. Mag. nat. Hist. (6) 14: 141  
Type locality: [INDIA] Shillong; Cherra Punji  
Note: This species is provisionally placed here. The original generic name is a homonym and no replacement name is available.

**Thysanoidma Hampson, 1891**

*Thysanoidma* Hampson, 1891, ill. typ. sp. Lep. Het. Brit. Mus. 8: 41, 142. Type species: *Thysanoidma octalis* Hampson, 1891 by monotypy.  
Note: This genus is doubtfully included in the Acenotropinae. It has possibly to be transferred to the Musotiminae. We wait with a formal transfer until the immature stages are known.

*Thysanoidma octalis* Hampson, 1891

Ill. typ. sp. Lep. Het. Brit. Mus. 8: 41, 142, pl. 155, fig. 4, 12  
Type locality: [INDIA] Nilgiri District, W. slopes of Nilgiri Hills, 3000 feet

*Thysanoidma stellata* (Warren, 1896) (*Paracymoriza*) **comb. n.**

Ann. Mag. nat. Hist. (6) 17 (99): 203

Type locality: [INDIA] Khasias

Note: This species is provisionally placed in *Thysanoidma* on the advice of S.-H. Yen (personal communication)

*Elophila* **Hübner, 1822**

*Elophila* Hübner, 1822, Syst.-alphab. Verz.: 54. Type species: *Phalaena nymphaealis* [Denis & Schiffermüller], 1775, an invalid emendation of *Phalaena Geometra nymphaea* Linnaeus, 1758, by subsequent designation by Whalley, 1966, Entomologist's Gaz. 17: 72.

*Elophila* (*Elophila*) **Hübner, 1822**

*Hydrocampus* Berthold, 1827 [in Latreille, 1827], Nat. Familien Tierreichs: 485. Type species: *Phalaena Geometra potamogata* Linnaeus, 1758 by monotypy.

*Hydrocampa* Stephens, 1829, Nom. Br. Insects: 46; Syst. Cat. Br. Insects (1): 163. Type species: *Pyrallis potamogalis* [Denis & Schiffermüller], 1775, an unjustified emendation of *Phalaena potamogata* Linnaeus, 1758, by subsequent designation by Duponchel, 1832, in Godart & Duponchel, Hist. nat. Lépid. Papillons Fr. 8 (2): 10

*Cyrtogramme* Yoshiyasu, 1985, Scientific Rep. Kyoto prefect. Univ. (Agric.) 37: 18 (key), 25. Type species: *Paraponx turbata* Butler, 1881 by original designation. [Established as a subgenus of *Elophila*.]

*Elophila interruptalis* (Pryer, 1877) (*Hydrocampa*)

Cistula ent. 2: 233, pl. 4, fig. 5

Type locality: [CHINA] Shanghai

*benesignata* Caradja, 1925 (*Nymphula nymphaeata* ssp.)

Memle Sect. Stint. Acad. rom. (3) 3 (7): 328

Type locality: [CHINA] Shanghai

*Elophila turbata* (Butler, 1881) (*Paraponyx* [sic])

Trans. ent. Soc. Lond. 1881: 586

Type locality: [JAPAN] Yokohama

*floralis* Leech, 1889 (*Leparodes*)

Entomologist 22: 71, pl. 4, fig. 1

Type locality: [JAPAN] Tsuruga [lectotype]; Fushiki

Note: The lectotype has been selected by Speidel 1984 (Neue ent. Nachr. 12: 58).

*sutschana* Ragonot, 1894 (*Hydrocampa*)

Annl. Soc. ent. Fr. 63: 174

Type locality: [RUSSIA] Amour [? Primorye, Sukan]

*sutschana* Hampson, 1900 (*Parthenodes*)

Trans. ent. Soc. Lond. 1900: 384

Type locality: [RUSSIA] Amurland, Sutschau [Sukan]

*Elophila difflualis* (Snellen, [1880] [in Veth, 1880-1892]) (*Hydrocampa*)

Midden-Sumatra 4 (8): 75

Type locality: [INDONESIA] Makassar (Celebes) [lectotype]; Fort de Kock; Boea (Sumatra); Java

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 72)

*enixalis* Swinhoe, 1885 (*Isopteryx*)

Proc. zool. Soc. Lond. 1885: 869

Type locality: [INDIA] Bombay

*linealis* Moore, 1888 [in Hewitson & Moore, 1879-88] (*Cymoriza*)

Descr. lepid. Insects Colln late Mr W. S. Atkinson (3): 210

Type locality: [INDIA] Calcutta

*osculatrix* Meyrick, 1933 (*Nymphula*)

Exot. Microlepid. 4: 394

Type locality: [THAILAND] Siam [lectotype]; [INDONESIA]

S. E. Borneo; [AUSTRALIA] Queensland

Note: The lectotype has been selected by Agassiz 1978 (Entomologist's Gaz. 29: 119).

*Elophila nigrilbalis* (Caradja, 1925) (*Nymphula difflualis* ssp.)

Memle Sect. Stint. Acad. rom. (3) 3 (7): 329

Type locality: [CHINA] Lienping [Province Guangdong: Lianping]

*Elophila manilensis* (Hampson, 1917) (*Nymphula*)

Ann. Mag. nat. Hist. (8) 19 (113): 369

Type locality: [PHILIPPINES] Manila

*Elophila melagnalis* (Agassiz, 1978) (*Nymphula*)

Entomologist's Gaz. 29: 121

Type locality: [SRI LANKA] Colombo

*Elophila rosetta* (Meyrick, 1938) (*Ambia*) **comb. n.**

Dt. ent. Z. Iris 52: 77

Type locality: [INDONESIA] Djokjakarta (Java)

*Elophila monetalis* (Snellen, 1880) (*Cymoriza*) **comb. n.**

Tijdschr. Ent. 23: 244; Snellen, 1884, Tijdschr. Ent. 27: 49 ('*Cymoriza montenali*'), pl. 5, fig. 3, 3 a.

Type locality: [INDONESIA] Makassar (Celebes) (Tijdsch. Ent. 27: 49).

*Elophila* (*Munroessa*) **Lange, 1956**

*Munroessa* Lange, 1956, Wasmann J. Biol. 14: 79, 81, 82 (keys), 100. Type species: *Nymphula serralinealis* Barnes & Benjamin, 1924 by original designation

*Elophila nigrolinealis* (Pryer, 1877) (*Hydrocampa*)

Cistula ent. 2: 233, pl. 4, fig. 6

Type locality: [CHINA] Shanghai

*Elophila separatilis* (Leech, 1889) (*Hydrocampa interruptalis*)

Entomologist 22: 71, pl. 4, fig. 2, 13

Type locality: [N. KOREA] Gensan [Wonsan, lectotype]; [CHINA] Ningpo [Ningbo]

Note: The lectotype has been selected by Speidel 1984 (Neue ent. Nachr. 12: 62).

*Elophila roesleri* Speidel, 1984 (*Elophila*)

Neue ent. Nachr. 12: 63

Type locality: [CHINA] Likang [Lijiang], Yunnan

*Elophila palliolatalis* (Swinhoe, 1890) (*Hydrocampa*) **comb. n.**

Trans. ent. Soc. Lond. 1890: 287

Type locality: [MYANMAR] Rangoon (Burma)

*Elophila sinicalis* (Hampson, 1897) (*Nymphula*) **comb. n.**

Trans. ent. Soc. Lond. 1897: 141

Type locality: [CHINA] Chekiang

*Elophila fengwhanalis* (Pryer, 1877) (*Lepyrodes*)

Cistula ent. 2: 235, pl. 4, fig. 11

Type locality: [CHINA] Feng Whan Shan [nr. Shanghai]

*Elophila oxygona* (Meyrick, 1894) (*Hydrocampa*)

Trans. ent. Soc. Lond. 1894: 470

Type locality: [INDONESIA] Sambawa

Note: This species is probably misplaced in the present genus.

### *Paracatachysta* Yoshiyasu, 1983

*Paracatachysta* Yoshiyasu, 1983, Akitu (n. s.) 50: 1. Type species: *Catachysta fuscalis* Hampson, 1893 by original designation

*Paracatachysta fuscalis* (Hampson, 1893) (*Catochysta*)

Ill. typ. sp. Lep. Her. Brit. Mus. 9: 52, 178, pl. 174, fig. 13

Type locality: [SRI LANKA] Kelani Valley (Ceylon)

*nyctopsis* Meyrick, 1894 (*Catachysta*)

Trans. ent. Soc. Lond. 1894: 475

Type locality: [INDONESIA] S. E. Borneo

### *Parapoynx* Hübner, [1825]

*Parapoynx* Hübner, [1825], Verz. bekannter Schmett. (1816-1826): 362. Type species: *Phalaena Pyralis stratiotatis* [Denis & Schiffermüller], 1775, an unjustified emendation of *Phalaena Geometra stratiotata* Linnaeus, 1758, by designation by Guenée, 1854 in Boisduval & Guenée, Hist. nat. Insectes (Spec. gén. Lépid.) 8: 269

\* *Parapoynx*; Guenée, 1854 [misspelling], Hist. nat. Insectes (Spec. gén. Lépid.) 8: 268

*Eustales* Clemens, 1860, Proc. Acad. nat. Sci. Philad. 1860: 216. Type species: *Eustales tedyuscongalis* Clemens, 1860 by monotypy

\* *Sironia* Clemens, 1860, Proc. Acad. nat. Sci. Philad. 1860: 218. Type species: *Sironia maculalis* Clemens, 1860 by monotypy

Note: *Sironia* Clemens, 1860 is a junior homonym of *Sironia* Hübner, 1823, Zuträge Samml. exot. Schmett. 2: 31 (Lepidoptera, Nymphalidae)

*Nymphaeella* Grote, 1880, N. Am. Ent. 1: 97. Type species: *Nymphaeella dispar* Grote, 1880 by monotypy

*Hydreuretis* Meyrick, 1885, Trans. ent. Soc. Lond. 1885: 427 (key), 435. Type species: *Hydrocampa tullialis* Walker, 1859 by subsequent designation by Klima, 1937, in Bryk, Lepid. Cat. (84): 72

*Microdracon* Warren, 1890, Ann. Mag. nat. Hist. (6) 6: 478. Type species: *Oligostigma bilinealis* Snellen, 1876, designated here

*Cosmophylla* Turner, 1905, Trans. R. Soc. S. Aust. 32: 85. Type species: *Cosmophylla oxygramma* Turner, 1908 by monotypy

*Parapoynx likiangalis* (Caradja, 1937) [in Caradja & Meyrick, 1937] (*Ambia*) comb. n.

Dt. ent. Z. Iris 51: 159

Type locality: [CHINA] Yülingshan near Likiang, 2800-3200 m (Yunnan)

*Parapoynx crisonalis* (Walker, 1859) (*Hydrocampa*)

List spec. lep. Ins. Brit. Mus. 19: 961

Type locality: [SRI LANKA] Ceylon

*hebraicalis* Snellen, 1880 (*Parapoynx*)

Tijdschr. Ent. 23: 240; Tijdschr. Ent. 27: 48, pl. 4, fig. 11, 11 a

Type locality: [INDONESIA] Makassar [Ujung Pandang] (Celebes) [lectotype]

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 76).

*myina* Meyrick, 1885 (*Parapoynx* [sic])

Trans. ent. Soc. Lond. 1885: 432

Type locality: [AUSTRALIA] Duaringa (Queensland)

*incurvalis* South, 1901 [in Leech, 1901] (*Nymphula*)

Trans. ent. Soc. Lond. 1901: 434

Type locality: [CHINA] Ichang

*takamukui* Shibuya, 1929 (*Nymphula*)

Insecta Matsumurana 3: 124, 127, pl. 5, fig. 10

Type locality: [JAPAN] Yanagawa, Fukuoka pref., Kyushu (Japan)

*Parapoynx fluctuosalis* (Zeller, 1852) (*Nymphula*)

*Parapoynx fluctuosalis fluctuosalis* (Zeller, 1852) (*Nymphula*)

Lepid. Microptera: 27

Type locality: [SOUTH AFRICA] Natal [lectotype]; Columbiën Note: The lectotype has been selected by Speidel 1984 (Neue ent. Nachr. 12: 84).

*luteivittalis* Mabilie, 1880 (*Nymphula*)

Annls Soc. ent. Belg. 23: xxvi

Type locality: Madagascar

*Parapoynx fluctuosalis linealis* Guenée, 1854 (*Parapoynx* [sic])

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 271

Type locality: Indes orientales

*chrysippusalis* Walker, 1859 (*Oligostigma*)

List spec. lep. Ins. Brit. Mus. 17: 432

Type locality: China

*obitalis* Walker, 1859 (*Oligostigma*)

List spec. lep. Ins. Brit. Mus. 17: 432

Type locality: [SRI LANKA] Ceylon [lectotype]; Australia Note: The lectotype has been selected by Speidel 1984 (Neue ent. Nachr. 12: 84).

*curta* Butler, 1879 (*Oligostigma*)

Entomologist's mon. Mag. 15: 270

Type locality: Hawaiian islands

*oryzalis* Wood-Mason, 1885 (*Parapoynx* [sic])

Some account of the Palan Byoo or Teindoung Bo: 1

Type locality: [MYANMAR] British Burma

*rugosalis* Möschler, 1890 (*Parapoynx* [sic]) syn. n.

Abh. senckenb. naturf. Ges. 16: 318

Type locality: [Puerto Rico] Portorico

*Parapoynx votalis* (Walker, 1859) (*Oligostigma*)

List spec. lep. Ins. Brit. Mus. 17: 433

Type locality: [SRI LANKA] Ceylon

*Parapoynx insectalis* (Pryer, 1877) (*Oligostigma*) comb. n.

Cistula ent. 2: 234, pl. 4, fig. 7

Type locality: [CHINA] Shanghai

Note: This species is placed in *Parapoynx* on the advice of S.-H. Yen (personal communication).

*Parapoynx leucostola* (Hampson, 1896) (*Nymphula*) comb. n.

Fauna Br. India (Moths) 4: 194

Type locality: [MYANMAR] Rangoon

*Parapoynx rectilinealis* Yoshiyasu, 1985 (*Parapoynx*)

Scientific Rep. Kyoto prefect. Univ. (Agric.) 37: 65

(key), 73 (*rectilinelis*)

Type locality: [JAPAN] Midoroike pond, Kyoto-shi, Kyoto pref.

*Parapoynx bilinealis* (Snellen, 1876) (*Oligostigma*)

Tijdschr. Ent. 19: 190 (key), 196, pl. 8, fig. 1 a-c

Type locality: [INDIA] Punjaub

*Parapoynx villidalis* (Walker, 1859) (*Oligostigma*?)

List spec. lep. Ins. Brit. Mus. 17: 435

Type locality: [MALAYSIA] Sarawak, Borneo

*sacadasalis* Walker, 1859 (*Hydrocampa*)

List spec. lep. Ins. Brit. Mus. 19: 963

Type locality: [AUSTRALIA] Moreton Bay

*unilinealis* Snellen, 1876 (*Oligostigma*)

Tijdschr. Ent. 19: 190 (key), 197, pl. 8, fig. 2 a, b

Type locality: [INDONESIA] Ambarawa (Java)

*Parapoynx vitalis* (Bremer, 1864) (*Oligostigma*)

Mem. Acad. imp. St. Petersb. (7) 8 (1): 66, pl. 6, fig. 3

Type locality: [RUSSIA] Kengka See

*regularis* Pryer, 1877 (*Oligostigma*)

Cistula ent. 2: 234, pl. 4, fig. 8

Type locality: [CHINA] Shanghai

*Parapoynx andreusialis* (Hampson, 1912) (*Oligostigma*) comb. n.

J. Bombay nat. Hist. Soc. 21: 1261, pl. G, fig. 43

Type locality: [INDIA] Nilgiris (Madras)

Note: This species is placed in the *bilinealis* complex of *Parapoynx* on the advice of S.-H. Yen (personal communication)

*Parapoynx stagnalis* (Zeller, 1852) (*Nymphula*)

Lepid. Microptera: 26

Type locality: [SOUTH AFRICA] Natal

*depunctalis* Guenée, 1854 (*Hydrocampa*)

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 274

Type locality: Indes orientales

*decussalis* Walker, 1859 (*Zebonia*?)

List spec. lep. Ins. Brit. Mus. 17: 481

Type locality: [SRI LANKA] Ceylon

*vestigialis* Snellen, [1880] [in Veth, 1880-1892] (*Cataglyphis*)

Midden-Sumatra 4 (8): 78

Type locality: [INDONESIA] Ambarawa (Java) [lectotype]; Sumatra; Celebes

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 87).

*billi* Tepper, 1890 (*Hydrocampa*)

Common native insects S. Australia 2: 49

Type locality: S. Australia

*Parapoynx medusalis* (Walker, 1859) (*Zebonia*?)

List spec. lep. Ins. Brit. Mus. 17: 486

Type locality: [AUSTRALIA] Moreton Bay

*dianalis* Schaus, 1906 (*Parapoynx* [sic])

Proc. U. S. natn. Mus. 30: 137

Type locality: [BRAZIL] Sao Paulo

*Parapoynx affinalis* Guenée, 1854 (*Parapoynx* [sic])

Hist. nat. Insectes (Spec. gén. Lépid.) 8: 270

Type locality: [INDIA] Inde centrale

*incommoda* Butler, 1881 (*Oligostigma*)

Proc. zool. Soc. London 1881: 180

Type locality: [YEMEN] Socotra

*fuscomarginata* Bethune-Baker, 1894 (*Nymphula*)

Trans. ent. Soc. Lond. 1894: 48, pl. 1, fig. 17

Type locality: [EGYPT] Alexandria

*alaicalis* Caradja, 1917 (*Nymphula*)

Dt. ent. Z. Iris 30: 21

Type locality: [KIRGHISTAN] Alai

*Parapoynx diminutalis* Snellen, 1880 (*Parapoynx*)

Tijdschr. Ent. 23: 242; Tijdschr. Ent. 27: 48, pl. 5, fig. 1

Type locality: [INDONESIA] Makassar [Ujung Pandang]

(Celebes) [lectotype]; Java

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 72)

*dicentra* Meyrick, 1885 (*Parapoynx* [sic])

Trans. ent. Soc. Lond. 1885: 431

Type locality: [AUSTRALIA] Duaringa (Queensland)

*pallida* Butler, 1886 (*Oligostigma*)

Trans. ent. Soc. Lond. 1886: 423

Type locality: [AUSTRALIA] Rockhampton

*uxorialis* Strand, 1919 (*Nymphula*) syn. n.

Ent. Mitt. 8: 102

Type locality: [TAIWAN] Anping (Formosa)

Note: The synonymy is established according to S.-H. Yen (*in litt.*)

*Parapoynx longialata* Yoshiyasu, 1983 (*Parapoynx*)

Tinea, Tokyo, 11 (13): 120

Type locality: [THAILAND] Kao Saming, Trad (Thailand)

*Parapoynx polydectalis* (Walker, 1859) (*Cataglyphis*)

List spec. lep. Ins. Brit. Mus. 17: 451

Type locality: [AUSTRALIA] Moreton Bay

*unguiculis* Snellen, [1880] [in Veth, 1880-1892] (*Parapoynx*)

Midden-Sumatra 4 (8): 77

Type locality: [INDONESIA] Silago (Sumatra) [lectotype];

Java

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 86).

*Parapoynx fulguralis* (Caradja, 1934) (*Nymphula*) comb. n.

Dt. ent. Z. Iris 47: 153

Type locality: [CHINA] coastal area of Guangdong; Guangdong border mounts to Yunnan; Kwanhsien (Sichuan)

*Parapoynx fregonalis* Snellen, 1880 (*Parapoynx*)

Tijdschr. Ent. 23: 241; Tijdschr. Ent. 27: 48, pl. 4, fig. 12

Type locality: [INDONESIA] Makassar [Ujung Pandang] (Celebes) [lectotype]; Bonthain (Celebes)

Note: The lectotype has been selected by Munroe, Diakonoff & Martin 1958 (Tijdschr. Ent. 101: 75).

*Parapoynx fusalis* (Hampson, 1896) (*Nymphula*)

Fauna Br. India (Moths) 4: 195

Type locality: [INDIA] Nagas

Note: The generic position of this species is preliminary.

*Parapoynx fuscicostalis* (Hampson, 1896) (*Nymphula*)

Fauna Br. India (Moths) 4: 195

Type locality: [INDIA] Calcutta

Note: The generic position of this species is preliminary.

*Parapoynx gangeticalis* Lederer, 1863 (*Parapoynx*)

Wien. ent. Monatschr. 7: 453, 485, pl. 18, fig. 5

Type locality: Ostindien

Note: This species is probably misplaced in the present genus.

***Nymphula* Schrank, 1802**

*Nymphula* Schrank, 1802, Fauna Boica 2 (2): 162. Type species: *Phalaena stagnata* Donovan, 1806 designated by International Commission on Zoological Nomenclature, opinion 1406.

*Pseudoparaponyx* Patocka, 1951, Ent. Listy 13: 108. Type species: *Phalaena stagnata* Donovan, 1806 by monotypy. Established as a subgenus of *Paraponyx* Hübner, [1825]

***Nymphula* *grisealis* Hampson, 1912 (*Nymphula*)**

J. Bombay nat. Hist. Soc. 21: 1261

Type locality: [SRI LANKA] Peradeniya (Ceylon)

Note: This species is probably misplaced in the present genus.

***Nymphula* *coenosalis* (Snellen, 1895) (*Hydrocampa*)**

Tijdschr. Ent. 38: 157

Type locality: [INDONESIA] Bantimorong (Zuid-Celebes)

Note: This species is probably misplaced in the present genus.

***Nymphula* *simplalis* (Snellen, 1890) (*Hydrocampa*)**

Trans. ent. Soc. Lond. 1890: 638

Type locality: [INDIA] Sikkim

Note: This species is probably misplaced in the present genus.

## TAXA REMOVED FROM THE ACENTROPINAE

**Genera belonging to Pyraustinae, Spilomelini*****Arxama* Walker, [1866]**

*Arxama* Walker, [1866] 1865, List spec. lep. Ins. Brit. Mus. 34: 1183. Type species: *Arxama subcervinalis* Walker, [1866] 1865 by monotypy

Note: This genus has been recently transferred to the Pyraustinae, Spilomelini (Shaffer, Nielsen & Horak 1996). It is therefore excluded from this catalogue.

***Gethosyne* Warren, 1896**

*Gethosyne* Warren, 1896, Ann. Mag. nat. Hist. (6) 18 (105): 221. Type species: *Gethosyne aequivocalis* Warren, 1896 by original designation

Note: This genus belongs to Pyraustinae, Spilomelini (M. Shaffer, personal communication).

***Gethosyne* *aequivocalis* Warren, 1896 (*Gethosyne*)**

Ann. Mag. nat. Hist. (6) 18 (105): 221

Type locality: [INDIA] Khasias

***Aetholix* Lederer, 1863**

*Aetholix* Lederer, 1863, Wien. ent. Monatschr. 7: 271 (key), 437. Type species: *Aediodes flavibasalis* Guenée, 1854 by monotypy.

Note: A figure of the male genitalia of the type species of this pyraustine genus is provided by Mathew & Ramdas Menon 1988: 88. There is no general revision of the pyraustine tribe Spilomelini and also no revision of the genus *Aetholix* and its relatives. Therefore, the generic position of the following species which we transfer to it from the Acentropinae must be regarded as preliminary.

***Aetholix* *litanalis* (Walker, 1859) (*Botys*?) comb. n.**

List spec. lep. Ins. Brit. Mus. 18: 706

Type locality: [MALAYSIA] Sarawak, Borneo

*titanalis* Hampson, 1897 (*Nymphula*), misspel.

Trans. ent. Soc. Lond. 1897: 144

*stenialis* Warren, 1891 (*Endotricha*?)

Ann. Mag. nat. Hist. (6) 8 (43): 68

Type locality: Borneo

***Aetholix* *meropalis* (Walker, 1859) (*Hydrocampa*?)**

List spec. lep. Ins. Brit. Mus. 17: 462

Type locality: [MALAYSIA] Sarawak, Borneo

*actoralis* Walker, 1859 (*Hydrocampa*?)

List spec. lep. Ins. Brit. Mus. 19: 962

Type locality: [MALAYSIA] Sarawak, Borneo

**Genera belonging to Musotiminae*****Eugauria* Snellen, 1901**

*Eugauria* Snellen, 1901, Tijdschr. Ent. 43: 290. Type species: *Eugauria compactalis* Snellen, 1901 by monotypy

Note: *Eugauria* is here transferred to the Musotiminae on the advice of S. H. Yen (*in litt.*)

***Eugauria* *albidentata* (Hampson, 1897) (*Cataglysta*)**

Trans. ent. Soc. Lond. 1897: 153

Type locality: [INDONESIA] Java

*compactalis* Snellen, 1901 (*Eugauria*)

Tijdschr. Ent. 43: 291, pl. 16, fig. 10

Type locality: [INDONESIA] Preanger, 1400-1800 m (West-Java)

**Unnamed genus*****Cataglysta* *angulata* Moore, [1885] 1884-7 (*Cataglysta*)**

Lepid. Ceylon 3: 300, pl. 181, fig. 12

Type locality: [SRI LANKA] Ceylon

Note: The *angulata* group of species is misplaced in *Cataglysta*, it belongs to the Musotiminae (S.-H. Yen *in litt.*) and merits a genus of its own which will be described by Yen.

Other species of this group are:

*seriopunctalis* Hampson, 1896 (*Nymphula*)

Trans. ent. Soc. Lond. 1897: 144

Type locality: Amboina; Fergusson Island (f.)

*polystictalis* Hampson, 1906 (*Nymphula*)

Ann. Mag. nat. Hist. (7) 18: 391

Type locality: Milne Bay (New Guinea)

*camptozonale* Hampson, 1897 (*Oligostigma*)

Trans. ent. Soc. Lond. 1897: 169

Type locality: Queensland; W. Australia; Amboina; Fergusson Island (f.)

*metastictalis* Hampson, 1917 (*Nymphula*)

Ann. Mag. nat. Hist. (8) 19 (113): 370

Type locality: Goodenough I.

*marginipuncta* Turner, 1937 (*Cataglysta*)

Proc. roy. Soc. Queensland 48: 77

Type locality: Cape York (Australia)

*pleonaxalis* Hampson, 1897 (*Nymphula*)

Trans. ent. Soc. Lond. 1897: 144

Type locality: Humboldt Bay; Fergusson Island, New Guinea

# ZUSAMMENFASSUNG

Der Katalog enthält alle Acentropinae-Taxa, die von der orientalischen Region beschrieben sind, und die Urbeschreibungen von jedem Taxon. Bezüglich der vielen neuen Gattungskombinationen verweisen wir auf den Katalog selbst.

Neue Synonyme: *Neoschoenobia decoloralis* Hampson, 1919 ist ein neues jüngeres Synonym von *Neoschoenobia testacealis* Hampson, 1900; *Catachysta dohrni* Hering, 1903 und *Ephormotris octopis* Meyrick, 1933 sind neue jüngere Synonyme von *Ephormotris dilucidalis* Guérin-Ménéville, [1832] 1829-1858 (*Botys*) comb. n.; *Oligostigma tripunctalis* Snellen, 1876 ist ein jüngeres primäres Homonym von *Oligostigma tripunctalis* Walker, [1866] 1865. Diese und ihr Ersatzname *Aulacodes klimai* Bryk, 1937 sind neue jüngere Synonyme von *Eoophyla parapomasalis* Hampson, 1897 (*Aulacodes*) comb. n.; *Oligostigma auropunctalis* var. *javanica* Strand, 1914 ist ein jüngeres Synonym von *Eoophyla excisalis* Snellen, 1901 (*Oligostigma*) comb. n.; *Oligostigma hapilistale* Strand, 1919 ist ein neues jüngeres Synonym von *Strepsinoma croesusalis* Walker, 1859 (*Catachysta*); *Stenricula* Snellen, 1901 und *Micromania* Swinhoe, 1894 (jüngeres Homonym von *Micromania* Christoph, 1893) werden vorläufig als neue jüngere Synonyme von *Paracymoriza* Warren, 1890 geführt. *Paraponyx* [sic] *rugosalis* Möschler, 1890 ist ein jüngeres Synonym von *Paraponyx fluctuosalis* Zeller, 1852 (*Nymphula*).

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# THE PLANT BUG TRIBE ORTHOTYLINI IN JAPAN (HETEROPTERA: MIRIDAE: ORTHOTYLINAE)\*

Yasunaga, T., 1999. The plant bug tribe Orthotylini in Japan (Heteroptera: Miridae: Orthotylinae). – Tijdschrift voor Entomologie 142: 143-183, figs. 1-155. [ISSN 0040-7496]. Published 22 September 1999.

The plant bug tribe Orthotylini of Japan is revised: 33 species are recognized in 11 genera. Two new genera, *Malacocorisella* and *Pseudoloxopidea*, and a new subgenus of the genus *Orthotylus*, *Yamatorthotylus*, are described. Thirteen new species are described: *Orthotylus* (O.) *fuscipennis*, O. (O.) *japonicus*, O. (*Yamatorthotylus*) *xanthopoda*, *Blepharidopterus striatus*, *Dryophilocoris lucidus*, D. *miyamotoi*, *Zanclus quercicola*, Z. *nakatanii*, Z. *ryukyuensis*, Z. *takahashii*, Z. *gigantoculus*, *Malacocorisella endoi*, and *Pseudoloxopidea pinicola*. Other known taxa are diagnosed and/or redescribed, and three species, *Orthotylus* (O.) *kurilensis* Kerzhner, O. (*Melanotrichus*) *parvulus* Reuter and *Pseudoloxops imperatorius* Distant, are reported from Japan for the first time. The female of *Mecomma japonica* Miyamoto is also documented. Brief notes on biology are given for 26 species. Photographs of 23 species and a key are also provided.

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Key words. – Miridae; Orthotylinae; Orthotylini; monographic revision; new genera; new subgenus; new species; Japan.

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Although the plant bug tribe Orthotylini is a large group including numerous described genera and species throughout the world, the Japanese fauna has been hitherto represented only by 17 species in 8 genera. Because the Japan Archipelago lies from 46°N to 24°N and contains cold temperate zone to subtropical islands, the Japanese fauna of the tribe is in great need of investigation.

My continuing studies of the Japanese Orthotylini have recognized a total of 33 species in 11 genera. Of these, 13 species were found to be undescribed, and 3 have not been previously recorded from Japan. In addition, 2 undescribed species were confirmed to be not accommodated by any known genera, and an undescribed species belonging to the genus *Orthotylus* also could not be placed in any known subgenera of the genus.

This paper is the first monographic revision documenting the Japanese fauna of the Orthotylini comprehensively, with descriptions of two new genera, a new subgenus of *Orthotylus*, and 13 new species. Three species are also recorded from Japan for the first time. All known taxa are diagnosed and/or redescribed. The female of *Mecomma japonica* Miya-

moto is described. Brief notes on plant association, habit and/or habitat are given for 26 species. A key is provided to distinguish the Japanese genera, subgenera and species of the tribe Orthotylini.

## MATERIAL AND METHODS

More than 2,000 dried specimens of 65 species (including exotic ones) were examined. Depositories of the material are abbreviated as follows:

- BMNH Department of Entomology, the Natural History Museum, London
- ELKU Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka
- HUES Biological Laboratory, Hokkaido University of Education, Sapporo
- IC Mr. Ichita's personal collection, Aomori
- MC Dr. Miyamoto's personal collection, Fukuoka
- NIAS National Institute of Agro-Environmental Sciences, Tsukuba, Ibaraki
- NSMT Department of Zoology, National Science Museum, Tokyo
- SEHU Systematic Entomology, Faculty of Agriculture, Hokkaido University, Sapporo

- USNM U. S. National Museum of Natural History,  
Washington, D. C.  
ZMAS Zoological Institute, Russian Academy of  
Sciences, St. Petersburg  
ZMUH Zoological Museum, University of Helsinki,  
Finland

Nymphs of 15 Japanese species preserved in 80% ethyl alcohol (HUES) were also observed. Photographs of live material were made with Olympus OM-System (OM-4Ti 35 mm camera with T10 Ringflash, Auto Extension Tube, and either 38 mm or 50 mm macro lenses).

All measurements in the text are given in millimeters. In the synonymic listings, only selected references are cited for each taxon; for detailed synonymic lists, see Carvalho (1958) and Schuh (1995). New distributional records for known species are each indicated by an asterisk (\*) after the name of a region.

### Checklist of Orthotylini in Japan

- Blepharidopterus* Kolenati, 1845  
*B. striatus* sp. n.  
*B. ulmicola* Kerzhner, 1977  
*Cyllocoris* Hahn, 1834  
*C. nakanishii* Miyamoto, 1965  
*C. vicarius* Kerzhner, 1988  
*Cyrtorhinus* Fieber, 1858  
*C. caricis* (Fallén, 1807)  
*C. lividipennis* Reuter, 1884  
*Dryophilacoriscus* Reuter, 1875  
*D. lucidus* sp. n.  
*D. miyamotoi* sp. n.  
*D. saigusai* Miyamoto, 1966  
*Malacocorisella* gen. n.  
*M. endoi* sp. n.  
*Mecomma* Fieber, 1858  
*M. japonica* Miyamoto, 1966  
*Mecommopsis* Kerzhner, 1979  
*M. cruciata* Kerzhner, 1979  
*Orthotylus* Fieber, 1858  
Subgen. *Kiorthotylus* Yasunaga, 1993  
*O. (K.) gotohi* Yasunaga, 1993  
Subgen. *Melanotrichus* Reuter, 1875  
*O. (M.) flavosparsus* (C. R. Sahlberg, 1841)  
*O. (M.) parvulus* Reuter, 1879  
Subgen. *Orthotylus* s. str.  
*O. (O.) fuscipennis* sp. n.  
*O. (O.) interpositus* Schmidt, 1938  
*O. (O.) japonicus* sp. n.  
*O. (O.) kurilensis* Kerzhner, 1997  
*O. (O.) pallens* (Matsumura, 1911)  
Subgen. *Pseudorthotylus* Poppius, 1914  
*O. (P.) bilineatus* (Fallén, 1807)  
Subgen. *Yamatorthotylus* subgen. n.

- O. (Y.) xanthopoda* sp. n.  
*Pseudoloxopidea* gen. n.  
*P. pinicola* sp. n.  
*Pseudoloxops* Kirkaldy, 1905  
*P. imperatorius* (Distant, 1904)  
*P. miyamotoi* Yasunaga, 1997  
*P. miyatakei* Miyamoto, 1966  
*P. takaii* Yasunaga, 1997  
*Zanchius* Distant, 1904  
*Z. gigantoculus* sp. n.  
*Z. nakatanii* sp. n.  
*Z. quercicola* sp. n.  
*Z. ryukyensis* sp. n.  
*Z. takahashii* sp. n.  
*Z. tarasovi* Kerzhner, 1988

### SYSTEMATIC PART

#### Tribe Orthotylini Van Duzee, 1916

Judging from the conspicuously variable structures exhibited in the external body and genitalia, it is somewhat difficult to consider the tribe as a monophyletic group. Although Linnavuori (1994) provided rather detailed characters for the tribe, only a few consistent key characters were documented. The most distinctive and reliable feature defining the Orthotylini is the presence of a pair of K-structures in the female genitalia (Schuh 1974). Further world level revision is required to redefine this enormous tribe properly.

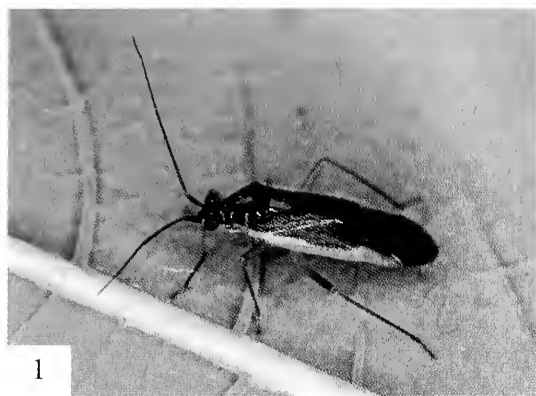
The Japanese orthotyline members are primarily recognized by the usually elongate body, and fleshy, apically convergent parempodia between the claws. Most species are associated with certain plants, whereas predation on other insects is frequently observed in laboratory tests as well as in the field.

#### *Orthotylus* Fieber

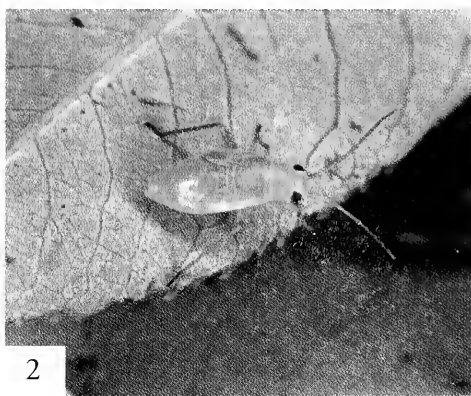
*Orthotylus* Fieber, 1858: 315, type species: *Cimex nassatus* Fabricius sensu Fieber 1858 (= *Orthotylus marginalis* Reuter, 1883: 380), subsequent designation by Kirkaldy 1906: 127; Schuh 1995: 147.

This is one of the largest genera among the Miridae, with approximately 300 described species worldwide. Only 5 species, *O. (O.) pallens*, *O. (O.) interpositus*, *O. (Kiorthotylus) gotohi*, *O. (Melanotrichus) flavosparsus* and *O. (Pseudorthotylus) bilineatus*, were previously recorded from Japan (Miyamoto 1969, 1977, Miyamoto & Yasunaga 1989, Todo & Yasunaga 1996, Yasunaga 1993).

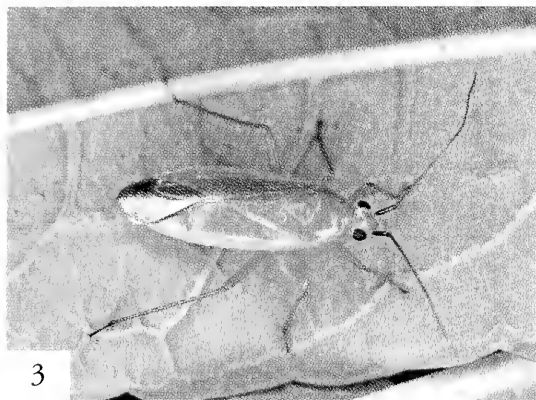
*Orthotylus* appears not to be a monophyletic group, and has not been defined by any consistent diagnostic characters. Some authors (Southwood 1953, Wagner 1952, 1973) proposed several subgenera and species



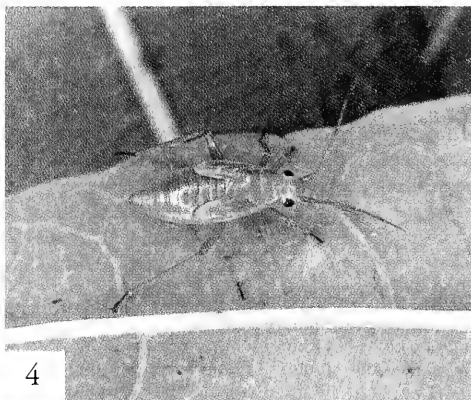
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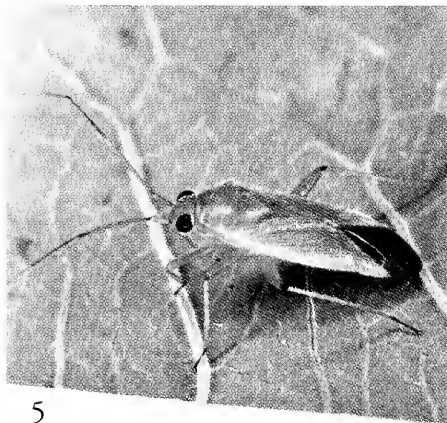
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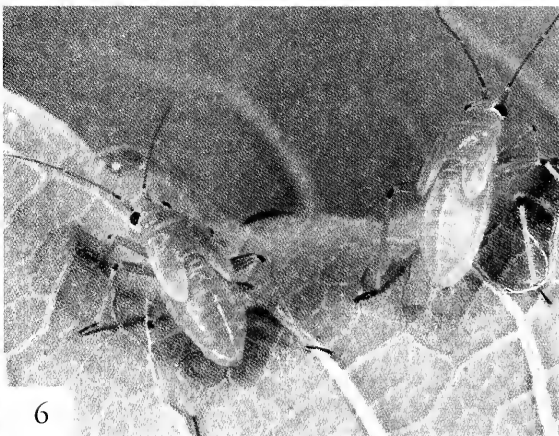
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6

Figs. 1-6. Adults (1, 3 & 5) and final instar nymphs (2, 4, 6) of *Orthotylini* spp. on willow in Hokkaido. - 1, 2, *O. pallens*; 3, 4, *O. interpositus*; 5, 6, *O. japonicus*.

groups for the classification of *Orthotylus*, but a further world level revision is required to correctly redefine these subgenera and species groups. As pointed out by Southwood & Leston (1959), several subgenera and species groups will be upgraded to the generic level.

Most species of the genus are plant-feeders and several are of economic importance, whereas predation on psyllids, aphids, and lepidopteran and dipteran larvae has been frequently observed during my continuous surveys and also reported by some authors (Wheeler & Henry 1992, Yasunaga 1996, etc.).

### Subgenus *Orthotylus* s. str.

Because the members of this subgenus exhibit great interspecific variation in the genitalia, several species groups have been proposed as mentioned above. However, these species groups were proposed mainly for European species, and are not always applicable to the members from other regions. Therefore, I do not use any of them here. Japanese species placed in the subgenus are recognized by the elongate or elongate oval body, principally green general coloration, dense, simple vestiture on the dorsal surface, peculiar shape of the parameres, 3 sclerotized appendages of the vesica (figs. 13, 17, 21, 25, 31, sclerites I-III), and developed female K-structure. The greenish coloration of the body is easily fading to yellow or brown after death.

In Japan the subgenus *Orthotylus* s. str. has been represented only by two species, *pallens* and *interpositus*, but the present study adds 3 species to the Japanese fauna.

### *Orthotylus* (*Orthotylus*) *pallens* (Matsumura) (figs. 1-2, 7-13, 32)

*Calocoris pallens* Matsumura, 1911: 39; Yasunaga et al. 1996: 92 (lectotype designated).

*Orthotylus* (*O.*) *pallens* – Miyamoto 1977: 232; Kerzhner 1988b: 833; Schuh 1995: 166; Todo & Yasunaga 1996: 43; Yasunaga 1996: 48.

**Diagnosis.** – Recognized by the moderate size, widely darkened head, pronotum, scutellum and hemelytra (fig. 1), striate frons, widened and flattened right paramere, and simple form of the K-structure. Very variable species in coloration; females are paler than males. This species is sometimes confused with *Stenotus binotatus* of the subfamily Mirinae, inhabiting gramineous grasses, but *Orthotylus pallens* is easily distinguished from it by the reduced pronotal collar and fleshy, apically convergent parempodia between the claws. The final instar nymph is recognized by the generally yellowish green body with a yellowish orange spot at the dorsal scent gland opening on the abdomen (fig. 2).

**Redescription.** – Body elongate, subparallel-sided;

dorsal surface pale green but usually widely darkened, uniformly clothed with silky, suberect pubescence. Head pale green, weakly granulated, not strongly shining, vertical, with silky, upright pubescence; vertex usually darkened mesally, with basal transverse carina; frons usually widely darkened, striolate by 3-4 pairs of transverse grooves; tylus dark brown. Antennae dark brown; segments I, II and basal part of III sometimes pale in ♀; lengths of segments I-IV (♂/♀): 0.48-0.53/0.48-0.53, 1.92-2.14/1.80-1.88, 0.96-1.11/0.96-1.04, 0.57-0.60/0.50-0.58. Rostrum pale brown, reaching but not exceeding apex of middle coxa; apical half of segment IV infusate. Pronotum pale green, usually widely darkened by symmetrical paired markings (that are sometimes reduced and becoming a pair of spots or stripes), shallowly and transversely rugose, uniformly clothed with silky, suberect pubescence; mesoscutum and scutellum varying from pale green to entirely dark brown, shagreened, bearing silky, suberect pubescence; pleura pale green, but partly infusate in ♂. Hemelytra pale green, uniformly clothed with silky, suberect pubescence; corium and clavus usually widely (or sometimes entirely) dark brown; inner margin and apex of cuneus sometimes darkened; membrane sombre greyish brown. Legs pale green; tibial spines pale brown; tarsi (especially tarsomeres III) darkened; lengths of hind femur, tibia and tarsus (♂/♀): 1.70-1.92/1.84-2.00, 2.64-2.86/2.64-2.84, 0.52-0.53/0.52-0.56; lengths of hind tarsomeres I-III (♂/♀): 0.16-0.21/0.18-0.20, 0.25-0.27/0.26-0.27, 0.25-0.28/0.24-0.28. Abdomen widely dark brown in ♂, unicolorously pale green in ♀. Male genitalia (figs. 7-13): Genital segment without any spines (7); left paramere with long, apically curved hypophysis (fig. 12); right paramere variable in general shape, widened and flattened, with minute teeth dorsally (figs. 8-11); vesical sclerite I with strongly curved and toothed apex; sclerite II strongly curved and twisted subapically; sclerite III toothed and 2-branched (fig. 13). Female genitalia (fig. 32): K-structure simple, gradually narrowed towards apex.

**Dimensions.** – ♂/♀: Body length 5.28-5.91/5.42-5.62; head width including eyes 0.99-1.01/1.00-1.01; vertex width 0.36-0.39/0.45-0.46; rostral length 1.48-1.66/1.60-1.68; mesal pronotal length 0.81-0.89/0.87-0.89; basal pronotal width 1.48-1.52/1.51-1.55; width across hemelytra 1.80-1.90/1.84-1.92.

**Distribution.** – Japan (Hokkaido, Honshu, Shikoku\*, Rishiri Is., Rebun Is., Yagishiri Is.\*), S. Kuril Isls., Russia (S. Sakhalin).

**Biology.** – This is one of the commonest species among the willow-inhabiting mirid bugs in Hokkaido (Todo & Yasunaga 1996). It seems to have a univoltine life cycle, and the adults usually emerge in late June. The eggs are laid in shoots of willow (*Salix* spp.,

Salicaceae) and hibernate. Predation on lepidopteran and dipteran larvae by the adults and final instar nymphs were frequently observed in laboratory tests (Yasunaga 1996).

Material examined. – More than 350 specimens (HUES, NSMT, SEHU, ZMAS) were examined from the following localities: JAPAN: Hokkaido: Soya: Kutsukata, Rishiri Is.; Kafukai, Rebun Is. – Rumoi: Yagishiri Is. – Kamikawa: Nakagawa T.; Moshiri & Shirakaba, Horokanai T.; Etanbetsu, Asahikawa C.; Mt. Asahidake, 200–800 m alt. & Tenninkyo Valley, Mts. Taisetsu; Katsurazawa Park, Ashibetsu C. – Sorachi: Sunagawa C.; Higashi-Naie, Naie T. – Ishikari: Aoyama, Tobetsu T.; Yausuba, Ishikari C.; Hokkaido Univ. Campus, Sapporo C.; Jozankei, Sapporo C. – Shiribeshi: Asari Pass, Otaru C.; Mt. Chisenupuri, 500–600 m alt., Niseko. – Iburi: Hokkaido Univ. Exp. Forest, Tomakomai C.; Kimundo Waterfall, Toya Lake. – Hidaka: Urakawa T. – Tokachi: Tokachi-Mitsumata, Kamishihoro T.; Rakko Riv., Hiroo T.; Obihiro C.; Kyushu Univ. Exp. Forest, Ashoro T.; Kimonto, Churui Vil. – Honshu: Ozegahara, Gunma Pref. (NSMT); Daimonzawa, Mt. Akadake, 2,000–2,500 m alt., Mts. Yatsugatake, Yamanashi Pref.; Minoto, Mt. Akadake, 2,000–2,500 m alt., Nagano Pref. – Shikoku: Haruno T., Kochi Pref. – KURIL ISLS.: Alekhino & Dubovoe, Kunashiri Is. (ZMAS) – RUSSIA, Sakhalin: Tunnaicha Lake, S. Sakhalin (lectotype ♀, SEHU); 12 km S of Kholmsk (holotype ♂ of *O. eliae* Kerzhner, ZMAS).

*Orthotylus (Orthotylus) interpositus* Schmidt  
(figs. 3–4, 14–17, 33)

*Orthotylus (O.) interpositus* Schmidt, 1938: 469; Kerzhner 1978: 43; Kerzhner 1988b: 833; Yasunaga 1993: 57, fig. 2G; Schuh 1995: 160.

*Orthotylus interpositus*? – Todo & Yasunaga 1996: 43.

*Orthotylus (O.)* sp. 1 – Endo et al. 1998: 17.

Diagnosis. – Recognized by the elongate body, immaculate pale green general coloration, usually darkened antennal segment I (fig. 3), and shape of the genitalia. The specimens from the eastern Palearctic Region are somewhat different from those from Europe in the larger body, longer antennae and legs, and developed and not conspicuously bifurcate female K-structures mesally overlapping each other (figs. 32–33). These different forms are considered to represent zoogeographical variation (Kerzhner pers. comm.). The final instar nymph resembles that of *pallens*, from which it is separable by the slender body and more deep greenish coloration (fig. 4).

Redescription. – Body generally pale green, elongate, parallel- (♂) or subparallel-sided (♀); dorsal surface uniformly clothed with silky, suberect pubescence. Head somewhat tinged with yellow, weakly shining, subvertical, bearing silky, erect pubescence; vertex transversely carinate basally; frons smooth, not striolate; tylus somewhat raised. Antennae pale brown; segment I, apex of II, and entire III and IV sometimes darkened especially in ♂; lengths of segments I–IV

(♂/♀): 0.55–0.60/0.55–0.62, 2.08–2.16/1.89–2.21, 1.03–1.23/1.00–1.18, 0.62–0.70/0.62–0.75. Rostrum pale brown, short, reaching but not exceeding middle coxa; apical half of segment IV infusate. Pronotum transversely and very narrowly wrinkled, uniformly clothed with silky, upright pubescence; mesoscutum and scutellum shagreened, bearing silky, suberect pubescence; pleura unicolorously pale. Hemelytra weakly shagreened, uniformly clothed with silky, suberect pubescence; embolium tinged with yellow; membrane pale greyish brown, with greenish veins. Legs rather long; tibial spines pale brown; tarsi dark brown; lengths of hind femur, tibia and tarsus (♂/♀): 2.06–2.16/2.16–2.23, 2.85–3.20/3.00–3.12, 0.62–0.68/0.60–0.65; lengths of hind tarsomeres I–III (♂/♀): 0.18–0.20/0.20–0.22, 0.27–0.35/0.32–0.34, 0.27–0.34/0.30–0.35. Abdomen unicolorously pale; apex of ♀ ovipositor infusate. Male genitalia (figs. 14–17): Genital segment with a pointed process above base of left paramere (14); right paramere broadened and toothed apically (fig. 15); vesica moderately curved in general shape; sclerite I smooth, gradually tapered towards apex; sclerite II with a branch at middle; sclerite III toothed and 3-branched (fig. 17). Female genitalia (fig. 33): K-structures well developed, somewhat asymmetrical and mesally overlapping each other.

Dimensions. – ♂/♀: Body length 6.29–6.58/6.62–6.72; head width including eyes 1.03–1.08/1.03–1.08; vertex width 0.40–0.46/0.46–0.53; rostral length 1.68–1.71/1.68–1.78; mesal pronotal length 0.90–0.94/0.94–0.96; basal pronotal width 1.56–1.61/1.63–1.68; width across hemelytra 1.89–1.97/2.06–2.24.

Distribution. Japan (Hokkaido), Kuril Isls, Palearctic Region. A typical Euro-Siberian species.

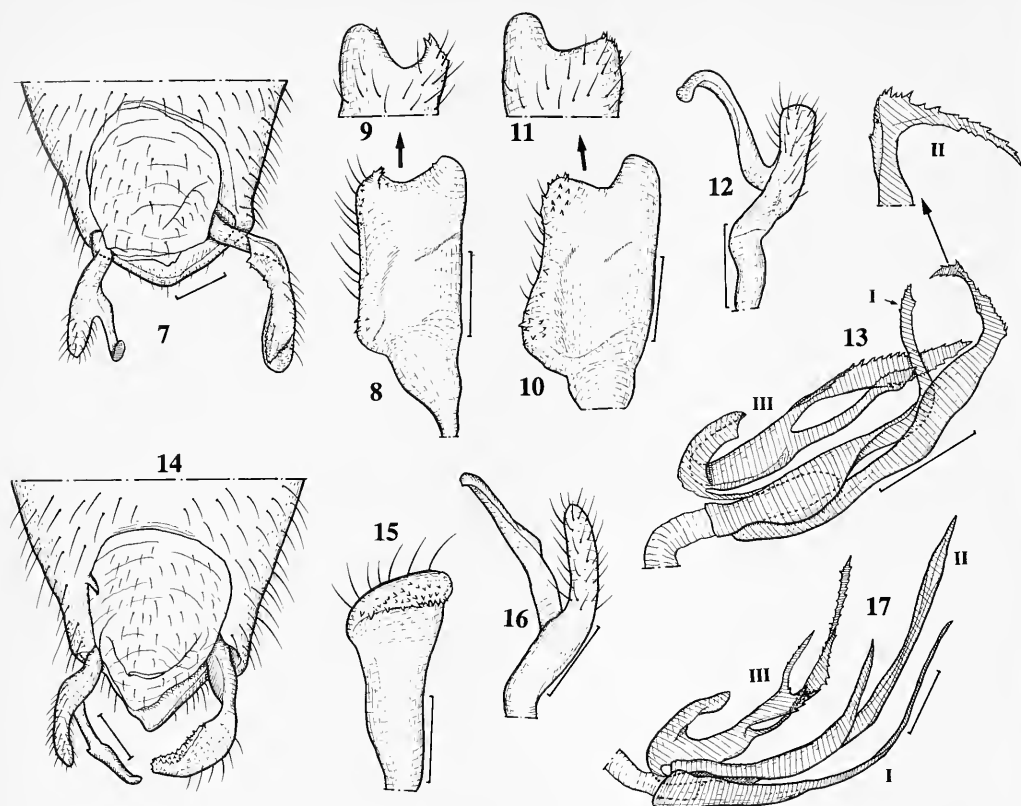
Biology. – This species is associated with willow, *Salix* spp., and is occasionally attracted to light. One generation per year is assumed for this mirid, and the final instar nymphs appear in mid July in Hokkaido.

Material examined. – 148 specimens (BMNH, HUES, MC, NSMT, ZMAS, ZMUH) from the following localities: JAPAN, Hokkaido: Kitami C., Abashiri (MC); Mitsumata, Kamishihoro T., Tokachi (NSMT); Ya'usuba, Ishikari C., Ishikari; Aoyama, Tobetsu T., Ishikari (HUES, ZMAS). – AUSTRIA: Pernitz (BMNH). – GERMANY: Passau & Halbendorf (ZMUH) – RUSSIA, Primorskij Kraj: 17km SW of Krounovka, near Mt. Medvezh'ja; Ussurijsk Natural Reserve; near Sergeevka; Rjazanovka, Khasanskij Dist.; Mt. Oblachnaja, 600–700 m alt. (HUES, ZMAS).

*Orthotylus (Orthotylus) kurilensis* Kerzhner  
(figs. 18–21, 35)

*Orthotylus (O.) kurilensis* Kerzhner, 1997a: 212.

Diagnosis. – Recognized by the slender body, nar-

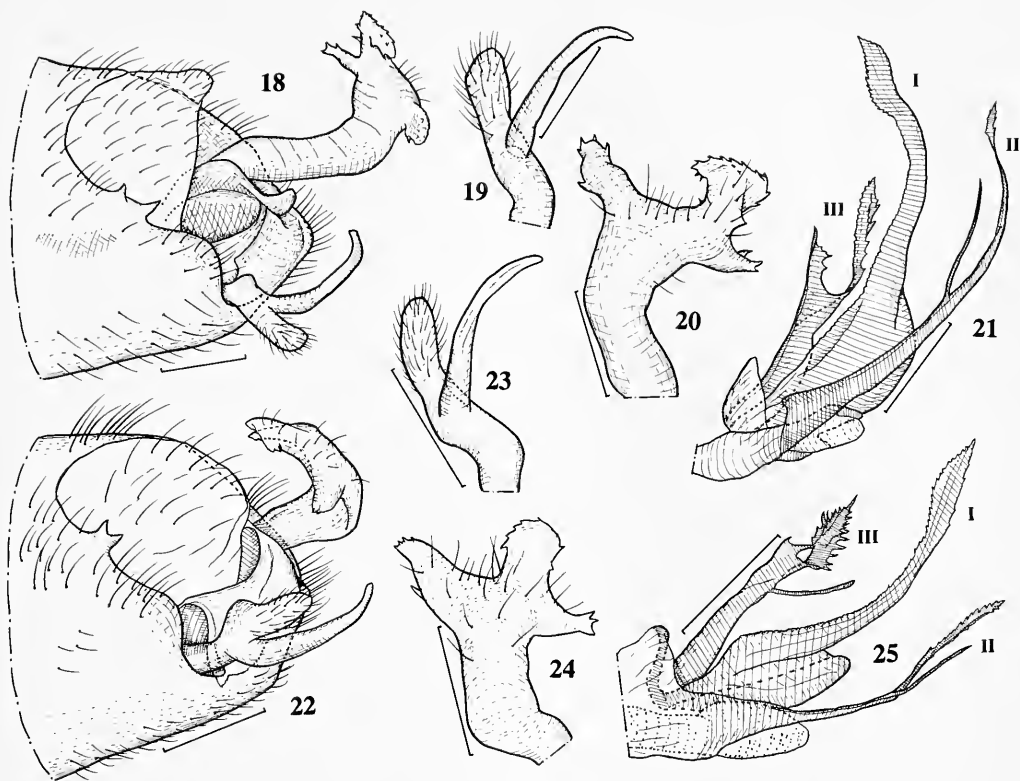


Figs. 7-17. Male genitalia of *Orthotylus pallens* (7-13) and *O. interpositus* (14-17). – 7, 14, genital segment with parameres in dorsal view; 8, 10, 15, right paramere in left lateral view; 9, 11, apex of right paramere in right lateral view; 12, 16, left paramere; 13, 17, vesica. Scales: 0.2 mm.

row head, vertex and pronotum, noticeably darkened antennae, anterior margin of the scutellum and ♂ abdomen, and peculiar shape of the right paramere. Similar in external appearance to *O. interpositus*, from which it is readily distinguished by the darkened anterior margin of the scutellum, and dark membrane veins. The yellow parts of the body described below may be pale green when alive although I have not seen live material.

**Redescription.** – Body slender, parallel- (♂) and subparallel-sided (♀); dorsal surface pale green, partly tinged with yellow, uniformly clothed with silky, slender, suberect pubescence. Head yellow, weakly shagreened, narrow, bearing sparse, silky, erect pubescence; vertex with a basal transverse carina. Antennae fuscous; segment I and basal part of II sometimes pale brown in ♀; lengths of segments I-IV (♂/♀): 0.48/0.45-0.48, 1.92-2.02/1.84-2.04, 0.93-0.96/0.88-0.96, 0.57-0.63/0.55-0.58. Rostrum pale brown,

reaching apex of hind coxa; apical half of segment IV infusate. Pronotum uniformly clothed with silky, suberect pubescence; calli tinged with yellow; mesoscutum yellow, with narrowly infusate mesal part and posterolateral margin, bearing sparse, silky pubescence; scutellum yellow, darkened along anterior margin, somewhat shagreened, with sparse, silky pubescence; pleura entirely yellow. Hemelytra somewhat shagreened, uniformly clothed with silky, suberect pubescence; embolium and cuneus tinged with yellow; membrane sombre greyish brown, darkened along veins. Legs pale brown; tibial spines pale brown; tarsi, especially tarsomeres III, darkened; lengths of hind femur, tibia and tarsus (♂/♀): 1.80-1.92/1.84-2.01, 2.68-2.96/2.71-2.98, 0.52-0.60/0.57-0.60; lengths of hind tarsomeres I-III (♂/♀): 0.18-0.20/0.19-0.20, 0.24-0.26/0.27-0.32, 0.25-0.27/0.25-0.29. Abdomen pale brown, widely darkened except for genital segment in ♂; apices of ♀ valvulae infusate. Male geni-



Figs. 18-25. Male genitalia of *Orthotylus kurilensis* (18-21) and *O. fuscipennis* (22-25). — 18, 22, genital segment with parameres in left dorsolateral view; 19, 23, left paramere; 20, 24, right paramere; 21, 25, vesica. Scales: 0.2 mm.

talia (figs. 18-21): Genital segment with two pointed processes above base of left paramere (fig. 18); hypophysis of left paramere slender and tapered apically (fig. 19); right paramere 3-branched apically, each branch provided with pointed teeth (fig. 20); vesical sclerite I developed basally; sclerite II with a median slender branch; sclerite III toothed and 2-branched (fig. 21). Female genitalia (fig. 35): K-structure squared, weakly divided into two apical lobes.

Dimensions. — ♂/♀: Body length 5.23-6.00/5.18-5.91; head width including eyes 0.92-0.94/0.91-0.96; vertex width 0.31-0.36/0.40-0.44; rostral length 1.44-1.49/1.51-1.61; mesal pronotal length 0.74-0.84/0.76-0.89; basal pronotal width 1.39-1.44/1.46-1.56; width across hemelytra 1.70-1.92/1.68-1.92.

Distribution. — Japan\* (Hokkaido, Honshu), Kuril Isls. (Urup Is.).

Material examined. — Hokkaido: 2♂, 1♀, Tokachi-Mitsumata, Kamishihoro T., Tokachi, 22.vii.1984, M. Tomo-

kuni (NSMT). — Honshu: 1♂, Hakuho Valley, Minamikoma-gun, Yamanashi Pref., light trap, 20.viii.1987, S. Nomura (HUES); 1♂, Ozegahara, Gunma Pref., 28-31.viii.1978, M. Sato (NSMT); 1♂, same locality, 20-24.viii.1979, M. Sato (NSMT); 1♂, 1♀, Yamanohana, Ozegahara, Gunma Pref., 20.viii.1979, M. Owada (NSMT).

*Orthotylus (Orthotylus) fuscipennis* sp. n.  
(figs. 22-25, 36)

Type material. — Holotype ♂, Utsumata, Maki Vil., Higashi-kubiki, Niigata Pref., Honshu, Japan, 5.vii. 1997, S. Sakurai (HUES). — Paratypes: 2♂, 1♀, same data as for holotype (HUES).

Diagnosis. — Recognized by the small, slender and widely darkened body, and relatively shagreened dorsum. This new species resembles *O. pallens*, from which it is easily distinguished by the even smaller body. Judging from the similarity of the male genital structure, *fuscipennis* is a close relative of *kurilensis*.

Description. — Body small, slender, parallel-sided; dorsal surface widely dark brown, shagreened, uniformly clothed with simple, pale, suberect setae. Head widely dark brown, granulated, bearing sparse, silky, erect pubescence; median part of vertex and lateral margin of frons sometimes pale brown; weak basal transverse carina of vertex darkened in ♂; frons shallowly striolate with 3-4 transverse rows of minute punctures. Antennae dark brown; segment I pale brown; basal part of segment II pale in ♂; lengths of segments I-IV (♂/♀): 0.43-0.46/0.46, 1.75-1.88/1.80, 0.86-0.94/0.96, 0.60-0.70/0.67. Rostrum pale brown, reaching apex of middle coxa; apical half of segment IV infusate. Pronotum dark brown, shagreened, with pale mesal stripe and calli, uniformly clothed with simple, pale, suberect setae; mesoscutum and scutellum dark brown, sometimes partly or widely pale brown, bearing sparse, suberect setae; pleura usually widely darkened and irregularly pale brown. Hemelytra dark brown, shagreened, uniformly clothed with simple, suberect setae; embolium, cuneus and narrow lateral margin of corium pale green; membrane dark greyish brown, with dark veins. Coxae and legs yellow; tibial spines pale brown; tarsomeres III dark brown; lengths of hind femur, tibia and tarsus (♂/♀): 1.60-1.66/1.73, 2.40-2.55/2.59, 0.48-0.57/0.50; lengths of hind tarsomeres I-III (♂/♀): 0.15-0.17/0.16, 0.24-0.28/0.24, 0.24-0.27/0.24. Abdomen dark brown. Male genitalia (figs. 22-25): Genital segment with a bifurcate process above base of left paramere (fig. 22); parameres similar in general shape to *kurilensis*; median apical branch of right paramere narrow (fig. 24); vesical sclerite I developed basally; sclerite II slender, with a median branch; sclerite III strongly twisted apically, with a smooth, slender branch subapically (fig. 25). Female genitalia (fig. 36): K-structure rather flat, inwardly toothed, with slender extension at apex.

Dimensions. — ♂/♀: Body length 4.46-4.76/4.80; head width including eyes 0.81-0.84/0.86; vertex width 0.30-0.32/0.38; rostral length 1.44-1.52/1.56; mesal pronotal length 0.69-0.72/0.77; basal pronotal width 1.12-1.20/1.30; width across hemelytra 1.36-1.44/1.63.

Distribution. — Japan (Honshu).

*Orthotylus (Orthotylus) japonicus* sp. n.  
(figs. 5-6, 26-31, 37)

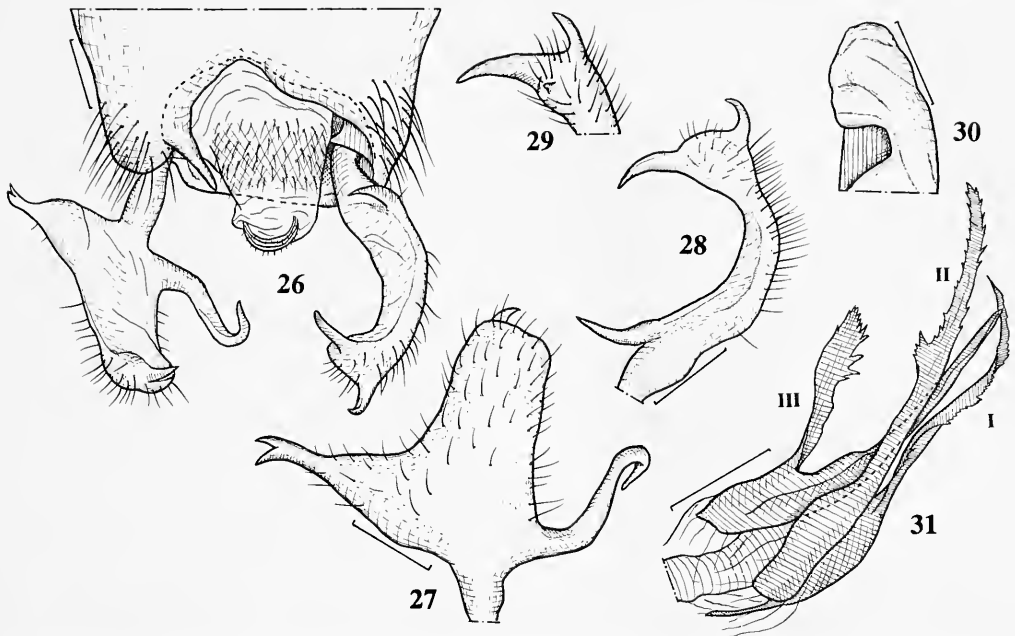
*Orthotylus (O.)* sp. 2 — Todo & Yasunaga 1996: 43; Endo et al. 1998: 17.

Type material. — Holotype ♂, Etanbetsu, Asahikawa C., Kamikawa, Hokkaido, Japan, on willow, 25.vii. 1998, T. & M. Yasunaga (HUES). — Paratypes: 202 specimens from the following localities in Japan: Hokkaido: Ootoinpeppu Vil., Kamikawa; Moshiri-Shi-

rakaba, Horokanai T., Kamikawa; Engaru T., Abashiri (ZMAS); Mt. Arashiyama, Asahikawa C.; same as holotype; Pin'neshiri, Shin-totsugawa Vil., Sorachi; Hassamu, Sapporo C., Ishikari (MC); Ya'usuba, Ishikari C., Ishikari; Hokkaido Univ. Campus, Sapporo C. (ZMAS); Seicha, Hidaka-horobetsu Riv., Ura-kawa T., Hidaka; Iwabokki-Suimon, Akkeshi T., Kushiro; Aoyama, Tobetsu T., Ishikari. — Honshu: Nishimeya Vil., Aomori Pref.; Kodera, Oe T., Yamagata Pref.; Ozegahara, Gunma Pref. (NSMT); Niitsu, Niigata Pref. (MC); Kakenoue, Muika T., Niigata Pref.; Myoko Plateau, Nagano Pref. (MC); Karuizawa, Nagano Pref. (MC); Nomugi-toge, Gifu Pref. (NSMT); Minamihizue-Shirami, Wakayama Pref. — Shikoku: Haruno T., Kochi Pref.; Hakawa, Ino T., Kochi Pref.

Diagnosis. — Recognized by the rather small and suboval body, immaculate pale green coloration, densely pubescent dorsum, a distinct dark spot at the base of each tibia (fig. 5), and significantly specialized form of the parameres. This new species is at first sight similar in general appearance to *O. kerkzhneri*, from which it is easily distinguished by the smaller and more oval body. Judging from the peculiar male genital structure, *O. japonicus* has only a remote relationship with any known congeners. The final instar nymph is readily recognized by the generally pale green body with a dark knee spot at the base of each tibia (fig. 6).

Description. — Body generally pale green, small, suboval; dorsal surface densely covered with silvery or silky, suberect pubescence. Head tinged with yellow, somewhat rounded, bearing silvery, erect pubescence; basal transverse carina of vertex weak. Antennae pale brown; apical part of segment II, and entire III and IV dark brown; lengths of segments (♂/♀): 0.43-0.48/0.43-0.48, 1.63-1.83/1.65-1.72, 0.93-1.01/0.93-0.96, 0.57-0.58/0.55-0.60. Rostrum pale brown, reaching apex of hind coxa; apical half of segment IV dark brown. Pronotum weakly shagreened, shining, rather tumid, densely clothed with silky, suberect pubescence; calli indistinct; mesoscutum and scutellum shagreened, densely pubescent. Hemelytra shagreened, densely clothed with silky, suberect pubescence; embolium somewhat tinged with yellow; membrane pale greyish brown. Legs pale green; extreme base (knee) of hind tibia infusate; tarsi dark brown; lengths of hind femur, tibia and tarsus (♂/♀): 1.53-1.73/1.75-1.85, 2.18-2.45/2.35-2.62, 0.48-0.53/0.50-0.53; lengths of hind tarsomeres I-III (♂/♀): 0.18-0.20/0.19-0.20, 0.24-0.28/0.24-0.26, 0.24-0.29/0.22-0.26. Abdomen almost unicolorously pale green; apices of / valvulae darkened. Male genitalia (figs 26-31): Genital segment shortened, with a strong pointed projection near base of left paramere (fig. 26); parameres peculiar in shape; left paramere



Figs. 26-30. Male genitalia of *Orthotylus japonicus*. – 26, Genital segment with parameres in dorsal view; 27, left paramere; 28, right paramere; 29, the same, apex of another specimen; 30, apex of theca; 31, vesica. Scales: 0.2 mm.

widened, with a hooked hypophysis, apical pointed process and dorsal bifurcate extension (fig. 27); right paramere with 3 pointed processes (fig. 28) and sometimes with an apical small process ventrally (fig. 29); vesical sclerites I and II toothed but not branched; sclerite III bifurcate (fig. 31). Female genitalia (fig. 37): K-structure widened, with rounded inner lobe.

Dimensions. – ♂/♀: Body length 4.56-4.85/4.89-5.20; head width including eyes 0.91-0.94/0.98-0.99; vertex width 0.40-0.44/0.45-0.48; rostral length 1.39-1.42/1.44-1.61; mesal pronotal length 0.72-0.80/0.81-0.82; basal pronotal width 1.27-1.37/1.41-1.49; width across hemelytra 1.65-1.73/1.84-1.92.

Distribution. – Japan (Hokkaido, Honshu, Shikoku).

Biology. – As pointed out by Todo & Yasunaga (1996) and Endo et al. (1998), *O. japonicus* is associated with willow (*Salix* spp.) growing along rivers. It obviously has a univoltine life cycle, and hibernates as egg. Predation on dipteran and lepidopteran larvae by the final instar nymphs was observed in laboratory tests.

### Subgenus *Kiorthotylus* Yasunaga

*Orthotylus* (*Kiorthotylus*) Yasunaga, 1993: 56, type species: *O. gotohi* Yasunaga, 1993, monotypic.

This subgenus is currently represented by a single Japanese species, *O. gotohi*, and is characterized by the small and slender body (fig. 39), long antennae, rostrum and legs, a mesal strong process and a smaller, left lateral blunt-tipped process on the male genital segment (fig. 46), unique shape of the parameres (figs. 47-48), 2-branched vesica that is curved at right angle (48), and asymmetrical K-structures (fig. 38).

*Kiorthotylus* is represented by a single, unique species inhabiting an azalea, *Rhododendron macrosepalum* Maxim. (Ericaceae).

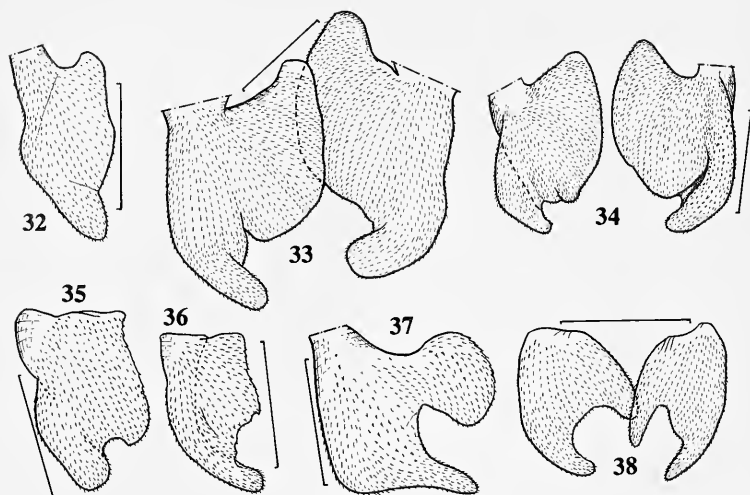
*Orthotylus* (*Kiorthotylus*) *gotohi* Yasunaga (figs. 38, 39-40, 46-49)

*Orthotylus* (*Kiorthotylus*) *gotohi* Yasunaga, 1993: 56.

Diagnosis. – Recognized by the slender body, immaculate pale green general coloration, uniformly distributed, pale brown, suberect setae on dorsum, long antennae, rostrum and legs (fig. 39), and unique shape of the genitalia (figs. 38, 46-49). Length 4.5-4.7; width 1.3-1.5. Detailed descriptions of the adult and final instar nymph were provided by Yasunaga (1993).

Distribution. – Japan (restricted areas of Honshu and Shikoku\*, where the host, *Rhododendron macrosepalum* grows).

Biology. – This interesting mirid is associated



Figs. 32-38.  
Female K-structures of *Orthotylus* spp. – 32, *O. pallens*; 33, *O. interpositus* from Hokkaido, Japan; 34, the same, from Germany; 35, *O. kurilensis*; 36, *O. fuscipennis*; 37, *O. japonicus*; 38, *O. gotohi*. Scales: 0.2 mm.

strictly with a wild azalea, *Rhododendron macrosepalum*, which is endemic to southwestern Japan. Although the leaves and stems of this plant are usually covered with soft 'adhesive' hairs, the mirid can walk quickly on them (figs. 39-40). Many insects cannot walk or several are sometimes 'captured' by the adhesive hairs as observed by Yasunaga (1992). According to Mr. S. Gotoh (pers. comm.), this mirid frequently feeds on cadavers of other insects captured by the adhesive hairs of *R. macrosepalum*. One generation per year is assumed for *O. gotohi*. It seems to hibernate as egg, and the newly emerged adults are found from late May to early June.

Material examined. – More than 200 specimens including paratypes (ELKU, HUES, MC, ZMAS) from the following localities: Honshu: Mt. Yahiko, Niigata Pref.; Ayabe C., Kyoto Pref.; Oishi, Kanaya T., Wakayama Pref.; Tsubaki, Shirahama T., Wakayama Pref.; Doro Valley, Tamakiguchi, Wakayama Pref.; Yasukawa Valley, Ohtoh Vil., Wakayama Pref.; Hongu T., Wakayama Pref.; Ichie, Hikigawa T., Wakayama Pref.; Kotonotaki, Susami T., Wakayama Pref. – Shikoku: Minaminoma, Tokushima Pref. Most specimens were collected on *Rhododendron macrosepalum* and some were attracted to light.

### Subgenus *Pseudorthotylus* Poppius

*Pseudorthotylus* Poppius, 1914: 66 (as genus), type species: *P. sordidus* Poppius, 1914, a junior synonym of *Capsus bilineatus* Fallén, 1807, monotypic.

*Orthotylus* (*Pseudorthotylus*) – Linnavuori 1994: 31.

*Orthotylus* (*Neomecomma*) Southwood, 1953: 443, type species: *Capsus bilineatus* Fallén, 1807, original designation (syn. by Linnavuori 1994: 31).

This subgenus is characterized by the unique exter-

nal appearance and genital structure. The male genitalia significantly differ from those exhibited in other members of *Orthotylus* (figs. 50-53). It was actually treated as a full genus in the previous works (Poppius 1914, Southwood & Leston 1959), but as the whole genus is in need of revision, the definitive treatment is beyond the scope of this study. Diagnostic characters were provided by Southwood (1953) as a synonym, *Neomecomma*.

### *Orthotylus* (*Pseudorthotylus*) *bilineatus* (Fallén) (figs. 50-53)

*Capsus bilineatus*, Fallén 1807: 102.

*Orthotylus* (*Neomecomma*) *bilineatus* – Southwood 1953: 433; Wagner & Weber 1964: 313; Miyamoto 1969: 78; Wagner 1973: 182; Kerzhner 1988b: 833; Schuh 1995: 151; Vinokurov & Kanyukova 1995: 112.

*Orthotylus* (*Pseudorthotylus*) *bilineatus* – Linnavuori 1994: 31.

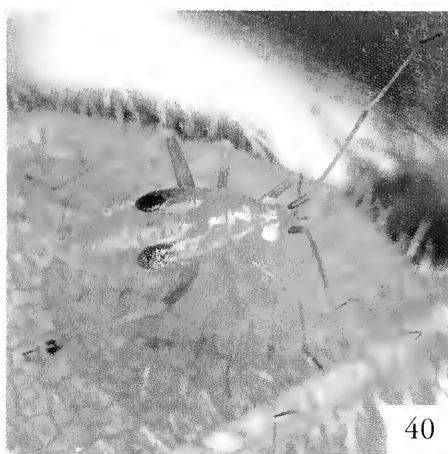
Diagnosis. – Easily recognized by the comparatively small size, oblong-oval body shape, pale whitish green general coloration, and noticeably darkened median part of the head, calli and posterior margin of the pronotum, mesal part of the scutellum and inner margins of the clavus and corium. Length 4.5-4.8; width 1.4-1.6. Detailed redescriptions were provided by Southwood (1953), Wagner (1952, 1973), Wagner & Weber (1964), Miyamoto (1969), etc.

Distribution. – Japan (Hokkaido), Palearctic Region.

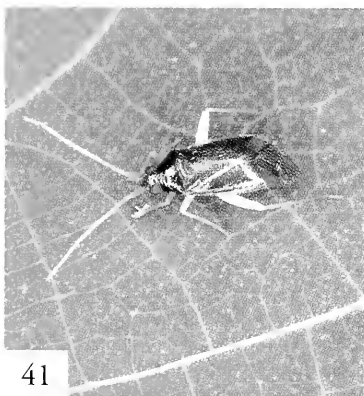
Biology. – Butler (1923) and Kerzhner (1988b) indicated *Populus* spp. (Salicaceae) as its host plants in England and continental Eurasia. In Hokkaido, this species has been collected from *Salix* spp., and occasionally attracted to light. The breeding hosts in Japan remain unknown.



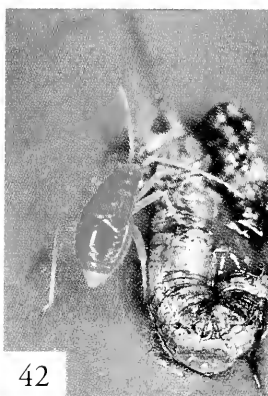
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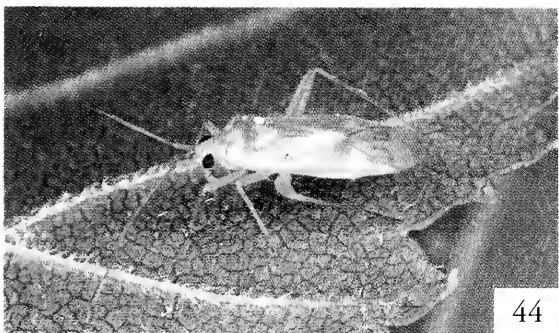
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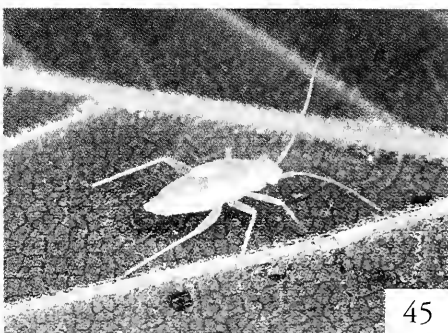
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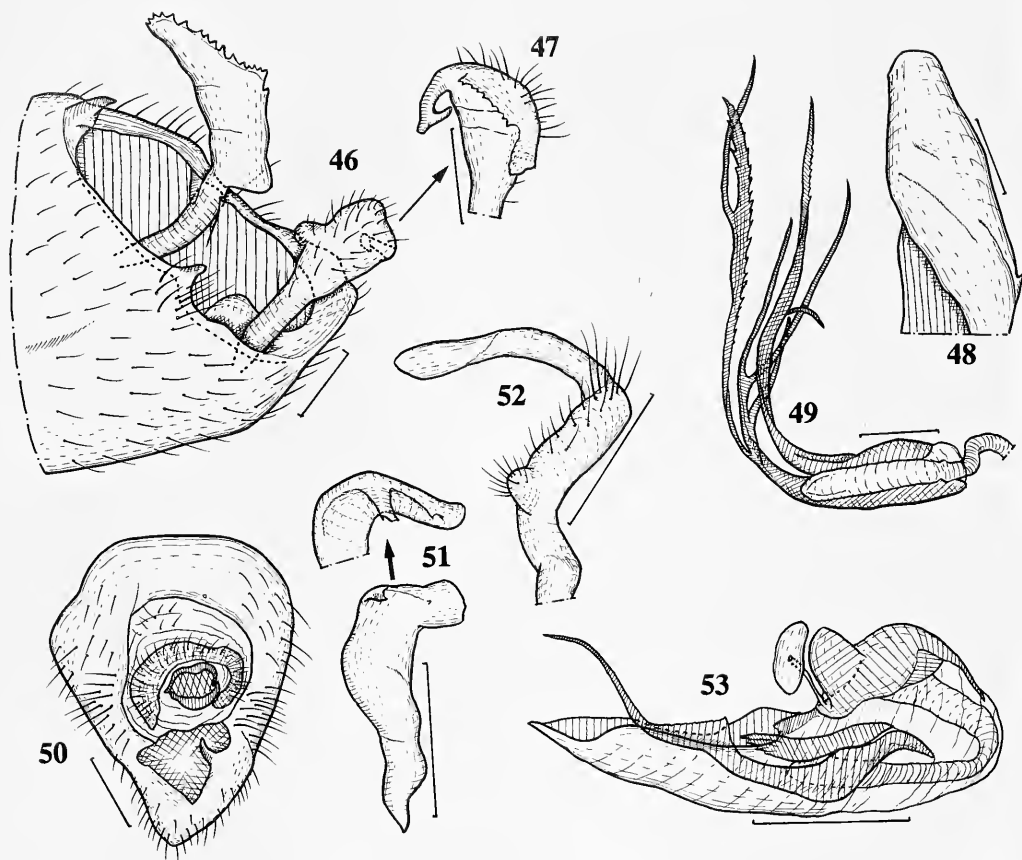


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45

Figs. 39-45. Adults (39, 41, 43, 44) and final instar nymphs (40, 42, 45) of *Orthotyldus gotohi* (39-40), *O. xanthopoda* (41-42), *O. flavosparsus* (43) and *Blepharidopterus ulmicola* (44-45).



Figs. 46-53. Male genitalia of *Orthotylus* spp. — 46-49, *O. gotohi*; 50-53, *O. bilineatus*. — 46, genital segment with parameres in left dorsolateral view (tergite X removed); 50, the same, without parameres in dorsal view; 51, right paramere; 47, 52, left paramere; 49, 53, vesica in right lateral view; 48, phallosome. Scales: 0.2 mm.

Material examined. — JAPAN: Hokkaido: 1 ♂, 1 ♀, Mitsumata, Kamishihoro T., Tokachi, 21-22.vii.1984, M. Tomokuni (NSMT); 1 ♂, Oniwaki, Rishiri Is., Soya, on *Salix* sp., 28-29.vii.1994, Y. Todo (HUES); 3 ♂, 16 ♀, Moshiri, Horokanai T., Kamikawa, at light, 1-5.viii.1994, T. & M. Yasunaga (HUES). — FINLAND: 1 ♀, Ispois (BMNH). — ENGLAND: 1 ♀, St. Beatenberg, viii. 1910 (BMNH); 1 ♀, Chiltern Hills, viii. 1915 (BMNH).

#### Subgenus *Yamatorthotylus* subgen. n.

Type species. — *Yamatorthotylus xanthopoda* Yasunaga, sp. n.

Diagnosis. — Recognized by the small size, red to dark dorsum (fig. 41), strong processes of the male genital segment (fig. 54), highly modified form of the parameres (figs. 54-55), 2-branched vesica (fig. 56), and long, slender K-structure (fig. 57).

Description. — Body small, elongate oval, nearly parallel-sided; dorsal surface red to dark chestnut brown, shining, almost impunctate, densely clothed with simple, brown, suberect pubescence. Head short; eyes almost contiguous to pronotum; vertex transversely carinate basally. Antennal segment I shorter than head width, about as long as IV. Rostrum reaching apex of middle coxa. Pronotum less than half the length of basal width, with narrow collar; calli weak; scutellum flat. Hemelytra longer than abdomen. Legs moderate in length; tibia with pale brown spines. Male genitalia (figs. 54-56): Genital segment with a pointed process right-laterally and a strong, apically bifurcate and basally toothed process; left paramere widened, with 4 processes; right paramere with a broad mesial projection and a pointed, apical process (figs. 54-55); vesica 2-branched, each branch bifurcate

and toothed apically (fig. 56). Female genitalia (fig. 57): K-structures remarkably elongate, slender, widely separated from each other.

Etymology. – ‘Yamato’ (= an old name of ‘Japan’) in combination with the generic name *Orthotylus*; gender masculine.

Discussion. – *Yamatorthotylus* is similar in external appearance, except in the reddish dorsum, to the nominotypical subgenus, but the genitalia are highly modified. Especially, the long, slender K-structure is unique, and considered to be an autapomorphy for the present new subgenus.

*Orthotylus (Yamatorthotylus) xanthopoda* sp. n.  
(figs. 41-42, 54-57)

Type material. – Holotype ♂, Kuroson, 550 m alt., Nishitosa Vil., Kochi Pref., Shikoku, Japan, 26.vii.1996, T. Yasunaga (HUES). – Paratypes: 53 specimens (ELKU, HUES, USNM) from the following localities in Japan: Hokkaido: Aoyama, Tobetsu T., Ishikari; Takaoka, Tomakomai C., Iburi. – Honshu: Mt. Nekogatake, Suzu C., Ishikawa Pref.; Mt. Obokodake, Totsugawa Vil., Nara Pref.; Mt. Wasamata, Kamikitayama Vil., Nara Pref.; Kitamata, Kawakami Vil., Nara Pref.; Gyojagaeri, Tenkawa Vil., Nara Pref.; Saka’ashi, Nachi-katsu’ura, Wakayama Pref.; Yasukawa Valley & Komori, Ohtoh Vil., Wakayama Pref.; Komori Riv., Kozagawa T., Wakayama Pref.; Chojabaru, Geihoku T., Hiroshima Pref. – Shikoku: Tsuchigoya, 1,400 m alt., Ehime Pref.; Omogo, Ehime Pref. (ELKU); Befu, Monobe Vil., Kochi Pref.; same as holotype. – Kyushu: Ohminami Pass, 500-600 m alt., Mt. Hikosan, Fukuoka Pref. (USNM).

Diagnosis. – Easily recognized by the small size, red to chestnut brown dorsum, and contrastingly creamy yellow legs (fig. 41). The reddish coloration enables us to distinguish it promptly from any of the east Asian congeners, but this new species resembles certain species of *Phylus* Hahn of the subfamily Phylinae, from which *O. xanthopoda* is distinguished by the fleshy, apically convergent parempodia between the claws. The final instar nymph is also readily recognized by the small, oval body, scarlet coloration and yellow apex of the abdomen (fig. 42).

Description. – Dorsal surface red to dark chestnut brown. Head dark brown. Antenna yellow; segments I and IV more or less tinged with red or sanguineous; lengths of segment I-IV (♂/♀): 0.31-0.38/0.34-0.42, 1.58-1.67/1.37-1.57, 0.52-0.57/0.55-0.64, 0.36-0.42/0.36-0.42. Rostrum pale brown; apex of segment IV infuscate. Pronotum, scutellum, and hemelytra unicolorous, densely clothed with simple, brown, suberect setae. Leg creamy yellow; femur partly tinged with red; tarsus pale brown with dark apex of tar-

somere III; lengths of hind femur, tibia and tarsus (♂/♀): 1.26-1.43/1.26-1.41, 1.86-2.06/1.82-2.06, 0.31-0.32/0.31-0.32; lengths of hind tarsomeres I-III (♂/♀): 0.11-0.13/0.12-0.15, 0.15-0.17/0.14-0.17, 0.18-0.22/0.17-0.19. Abdomen unicolorous, reddish brown to dark chestnut brown. Genitalia as mentioned in subgeneric description.

Dimensions. – ♂/♀: Body length 4.05-4.23/4.20-4.50; head width including eyes 0.72-0.75/0.65-0.70; vertex width 0.28-0.31/0.31-0.32; rostral length 1.25-1.27/1.25-1.32; mesal pronotal length; 0.46-0.48/0.46-0.51; basal pronotal width 0.95-1.02/1.02-1.06; width across hemelytra 1.25-1.33/1.29-1.40.

Distribution. – Japan (Hokkaido, Honshu, Shikoku, Kyushu).

Biology. – This new species was collected by sweeping various broadleaved trees, such as *Deutzia crenata* Sieb. et Zucc. (Saxifragaceae), *Fraxinus mandshurica* Rupr., *Syringa reticulata* (Bl.) Hara (Oleaceae), *Mallostus japonicus* (Thunb. ex Murray) Muell. (Euphorbiaceae) and *Acer* sp. (Aceraceae), and often attracted to light. The nymphs were found on *Deutzia crenata* in the Kii Peninsula and *Fraxinus mandshurica* in Hokkaido. Predation on unidentified lepidopteran larvae by both the adults and nymphs (fig. 42) was observed in laboratory tests. An univoltine life cycle is assumed for *O. xanthopoda*, and the newly emerged adults appear in early June in southern Japan and in mid July in Hokkaido.

### Subgenus *Melanotrichus* Reuter

*Orthotylus (Melanotrichus)* Reuter, 1875a: 1: 92, type species: *Phytocoris flavosparsus* C. R. Sahlberg, 1841, subsequent designation by Kirkaldy 1906: 127; Schuh 1995: 148.

This subgenus is primarily characterized by the small body, both dark setae and silvery pubescence on dorsum (fig. 43), shape of the parameres (figs. 58-63), and simple form of the vesica. This is treated as a full genus by some authors (e.g., Henry & Wheeler 1988, Wheeler & Henry 1992), but I treat it here as subgenus until a comprehensive revision will be accomplished.

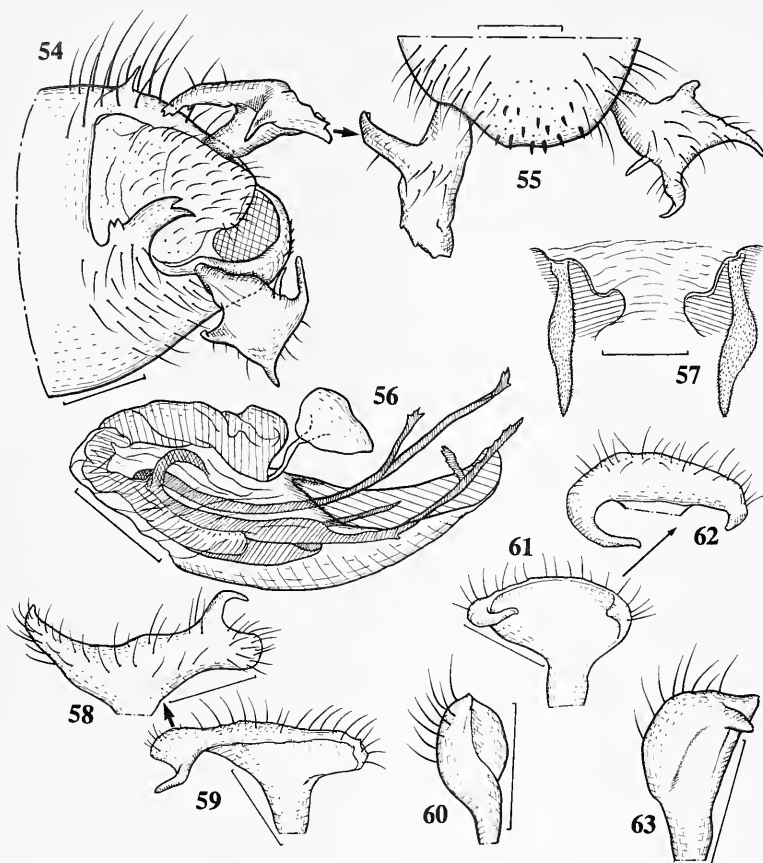
*Orthotylus (Melanotrichus) flavosparsus* (Sahlberg)  
(Figs. 43, 58-60)

*Phytocoris flavosparsus* C. R. Sahlberg 1841: 411.

*Orthotylus flavosparsus* – Yasunaga et al. 1996: 93 (= *Orthotylus nigropilosus* Lindberg, 1934).

*Orthotylus (Melanotrichus) flavosparsus* – Reuter 1875b: 35; Wagner & Weber 1964: 329; Miyamoto 1965: 98, pl. 49, fig. 22; Wagner 1973: 229; Kerzhner 1988b: 833; Lee & Kwon 1991: 34; Schuh 1995: 157 (= *Tuponia guttula* Matsumura, 1917); Vinokurov & Kanyukova 1995: 112.

*Tuponia guttula* Matsumura, 1917: 432; Yasunaga et al. 1996: 93 (lectotype designation).



Figs. 54-63. Male and female (57) genitalia of *Orthotylus* spp. – 54-57, *O. xanthopoda*; 58-60, *O. flavosparsus*; 61-63, *O. parvulus*. – 54, genital segment with parameres in left dorsolateral view; 55, the same, in ventral view; 56, vesica with phallosome in left lateral view; 58-59, 61-62, left paramere; 60, 63, right paramere. Scales: 0.2 mm for 54-57, 0.1 mm for 58-63.

**Diagnosis.** – Recognized by the small, elongate oval ( $\delta$ ) or oval ( $\eta$ ) body, shiny pale green general coloration, blackish setae on dorsum, patches of the silvery pubescence on the hemelytra (fig. 43), and shape of the parameres (figs. 58-60). Length 3.6-3.9; width 0.9-1.2. Because of its economic importance, this species has appeared in many papers, and re-descriptions and/or figures were presented by Southwood (1953), Wagner (1952, 1973), Wagner & Weber (1964), Miyamoto (1965), Kelton (1980), etc.

**Distribution.** – Japan (Hokkaido, Honshu, Kyushu), Holarctic Region.

**Biology.** – This common holarctic species is predominantly associated with *Chenopodium* spp. (Chenopodiaceae), and the coloration and dorsal vestiture are cryptic, harmonious with the flowers (fig. 43). It has bivoltine life cycles as reported by Southwood & Leston (1959), and the adults appear in June and September in Hokkaido. Since it is a well

known pest injurious to sugar beet (*Beta vulgaris* L., Chenopodiaceae), the ecology was studied by some workers as summarized by Wheeler & Henry (1992). The chromosomes were also documented by Southwood (1957), Muramoto (1975), etc.

**Material examined.** – 163 specimens (BMNH, HUES, SEHU) from the following localities: JAPAN: Hokkaido: Etanbetsu, Asahikawa C., Kamikawa; Higashikawa T., Kamikawa; Ya'usuba, Ishikari C., Ishikari; Ainosato, Sapporo C., Ishikari; Maruyama, Sapporo C. (paralectotype  $\eta$  of *Tuponia guttula* Matsumura, SEHU); Benkebetsu, Tobetsu T., Ishikari; Otarunai, Otaru C., Shiribeshi; Heiwa, Ashoro T., Tokachi; Kawayu, Teshikaga T., Kushiro; Takaoka, Tomakomai C., Iburi. – Honshu: Yamanouchi, Murayama C., Yamagata Pref.; Iwate Pref. (2  $\eta$ , lectotype and paralectotype of *Tuponia guttula*, SEHU). – RUSSIA: Rjazanovka, Khasanskij Dist., S. Primorskij Kraj; Neryungri, Mts. Stanovoj, S. Yakutia, SE. Siberia. – SWITZERLAND: No further data (BMNH). – TURKEY: Kutahya (BMNH).

*Orthotylus (Melanotrichus) parvulus* Reuter  
(figs. 61-63)

*Orthotylus parvulus* Reuter, 1879: 38.

*Orthotylus (Melanotrichus) parvulus* – Carvalho 1958: 117; Wagner 1973: 239; Kerzhner 1988a: 71; 1988b: 834; Lee & Kwon 1991: 34; Vinokurov & Kanyukova 1995: 112; Schuh 1995: 166.

*Orthotylus (Melanotrichus) namphoensis* Josifov, 1976: 143 (synonymised by Kerzhner 1988a: 71).

Diagnosis. – Recognized by the tiny, oval body, pale green general coloration, brown setae on the dorsum, sparsely and uniformly distributed silvery pubescence on the hemelytra, and shape of the parameres (figs. 61-63). Length 3.0-3.2; width 1.1-1.3. Detailed redescrptions were provided by Wagner (1973) and Josifov (1976, as *O. namphoensis*). This is a close relative of *flavosparsus*, from which it can be distinguished by the even smaller body, brown setae and sparse silvery pubescence on dorsum, and different shape of the parameres.

Distribution. – Japan\* (Tsushima Is.), Palearctic Region (from Mediterranean area to Korean Peninsula).

Biology. – Kerzhner (1988b) recognized *Salicornia europaea* L. (Chenopodiaceae) as its host plant. In Tsushima Island, Dr. M. Hayashi (pers. comm.) collected this mirid from *Suaeda maritima* (L.) Dumort. that also belongs to the Chenopodiaceae.

Material examined. – 10♂, 2♀, Shushi, Kamiagata-gun, Tsushima Is., Nagasaki Pref., 16.vii.1995, M. Hayashi (HUES). – BULGARIA: 3♂, 3♀, Burgas, 8.x.1960, M. Josifov (ZMUH). – RUSSIA: 1♂, Ross. mer., Type no. 3442 (lecto-type, Reuter (1879) indicated the locality as Astrakhan, see Kerzhner (1997b), ZMUH).

### *Blepharidopterus* Kolenati

*Blepharidopterus* Kolenati, 1845: 107 (as subgenus of *Polymerus* of the Mirinae), type species: *Lygaeus angulatus* Falén, 1807, subsequent designation by Kirkaldy 1906: 128; Schuh 1995: 83.

This genus has been liable to be confused with *Orthotylus* Fieber, but is distinct in having the rather small and slender body, long antennae and rostrum, pale brown or dark brown suberect setae and silvery recumbent pubescence on the semitransparent hemelytra, ventral spine-like setae on the male genital segment, birdhead-shaped left paramere, slender right paramere, and simple form of the vesica. Judging from the male genital structure, relationship between *Blepharidopterus* and *Orthotylus* is only superficial.

*Blepharidopterus* currently contains 10 species in the Holarctic Region.

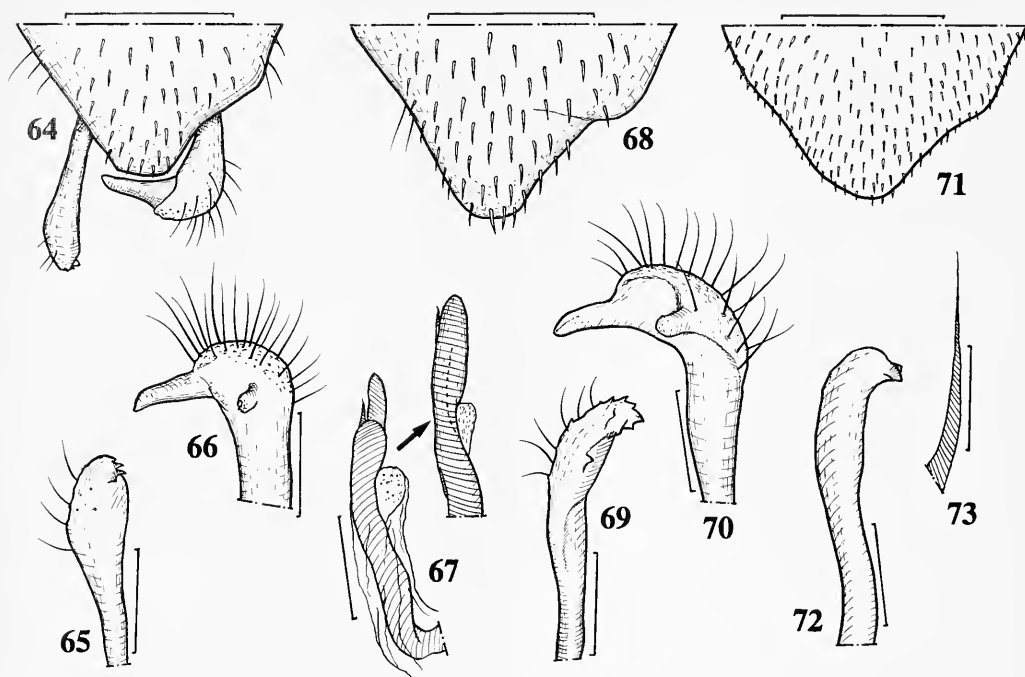
*Blepharidopterus ulmicola* Kerzhner, 1977  
(figs. 44-45, 64-67)

*Blepharidopterus ulmicola* Kerzhner, 1977: 19; 1988b: 832; Lee et al. 1994: 12; Schuh 1995: 85; Endo et al. 1998: 17.

Diagnosis. – Recognized by the small size, uniformly pale green general coloration (fig. 44, easily fading to yellow after death), pale suberect setae and silvery pubescence on the hemelytra, and shape of the male genitalia (figs. 64-67). The final instar nymph is recognized by the uniformly pale green, slender body (fig. 45). This species is closely related to the continental Palearctic *B. diaphanus* (Kirschbaum), from which it can be distinguished by the narrower head, shorter antennal segment III, long and sparse spine-like setae on the male genital segment, 3-4 apical teeth on the right paramere, and much shorter vesical appendage. In *diaphanus*, which may occur in Japan, the spine-like setae on the male genital segment are short and dense, the right paramere has 2-3 apical teeth, and the vesical appendage is much longer (figs. 71-73).

Redescription. – Body uniformly pale green, elongate oval, small; dorsal surface densely clothed with pale, suberect setae. Head vertical, bearing sparse, suberect, silky pubescence; vertex weakly margined by basal transverse carina. Antennae pale brown; segments III and IV brown; lengths of segments I-IV (♂/♀): 0.40-0.44/0.43-0.46, 1.56-1.64/1.60-1.76, 1.17-1.32/1.20-1.40, 0.45-0.53/0.48-0.54. Rostrum pale brown, reaching hind coxa; apex of segment IV dark brown. Pronotum, mesoscutum and scutellum weakly shagreened, clothed with pale, suberect setae. Hemelytra semitransparent, clothed with pale, suberect setae and silvery, recumbent pubescence; membrane pale brown, semitransparent, with pale green veins. Legs pale brown, tibiae tinged with brown, with pale brown spines; tarsi dark brown; lengths of hind femur, tibia and tarsus (♂/♀): 1.65-1.68/1.68-1.90, 2.56-2.64/2.64-2.76, 0.43-0.44/0.48-0.51; lengths of hind tarsomeres I-III (♂/♀): 0.13-0.15/0.14-0.17, 0.20-0.22/0.21-0.24, 0.20-0.21/0.22-0.24. Abdomen uniformly pale green. Male genitalia (figs. 63-66): Spine-like setae on genital segment comparatively sparse (fig. 63); left paramere birdhead-shaped, provided with long setae (fig. 65); right paramere slender, with 3-4 apical teeth (fig. 64); vesica with a very short spine subapically (fig. 66).

Dimensions. – ♂/♀: Body length 3.72-3.89/4.32-4.49; head width including eyes 0.76-0.77/0.72-0.75; vertex width 0.24-0.27/0.33-0.36; rostral length 1.27-1.32/1.39-1.44; mesal pronotal length 0.48-0.51/0.57-0.60; basal pronotal width 0.98-1.02/1.20; width across hemelytra 1.27-1.30/1.46-1.56.



Figs. 64-73. Male genitalia of *Blepharidopterus* spp. — 64-67, *B. ulmicola*; 68-70, *B. striatus*; 71-73, *B. diaphanus* from Primor'je, Russia. — 64, 68, 71, genital segment in ventral view; 65, 69, 72, right paramere; 66, 70, left paramere; 67, vesica; 73, vesical spine. Scales: 0.1 mm for 65-67, 69-70, 72-73, 0.2 mm for 64, 68, 71.

Distribution. — Japan (Hokkaido), S. Kuril Isl., Russia (Khabarovskij Kraj, Amur, Primorskij Kraj and Sakhalin), Mongolia.

Biology. — Kerzhner (1988b) indicated *Ulmus* spp. (Ulmaceae) as the host plants of *B. ulmicola*. Actually, in Japan most specimens examined in this study were collected from *Ulmus japonica* Nakai, but some were found on *Juglans ailantifolia* Carr. (Juglandaceae), *Alnus* spp. (Betulaceae), and *Salix* spp. (Salicaceae).

Material examined. — 155 specimens (HUES, ZMAS) from the following localities: JAPAN: Hokkaido: Mt. Asahidake, 500-800 m alt., Mts. Taisetsu, Kamikawa; Tenninkyo Valley, Mts. Taisetsu, Kamikawa; Aoyama, Tobetsu T., Ishikari; Ainosato, Sapporo C.; Berabonai-Takuhoku, Ashoro T., Tokachi; Takaoka, Tomakomai C., Iburi. — RUSSIA: Blagoveshensk, Amur (holotype, ZMAS); Khabarovsk (3 paratypes, ZMAS). — MONGOLIA: East Ajmak, Mt. Derkhin-Tsagan-Obo, 60 km ENE of Bajan Burd (3 paratypes, ZMAS).

*Blepharidopterus striatus* sp. n.  
(figs. 68-70)

Type material. — Holotype: ♂, Mt. Wasamata, Kamikitayama Vil., Nara Pref., Honshu, Japan, 24-25.vii.1992, Y. Nakatani (HUES). — Paratype: 1♂, same data as for holotype (HUES).

Diagnosis. — Recognized by the slender body, dark brown antennae and tibiae, darkened posterior part of the pronotum, dark spot near posterior corner of the membrane vein, and distinctly toothed apical part of the right paramere (fig. 68). This new species is related to *B. diaphanus* (Kirschbaum) and *B. ulmicola* Kerzhner, from which it is easily distinguished by the longer body and darkened posterior margin of the pronotum.

Description. — Male: Body slender, parallel-sided; dorsal surface yellowish green, clothed with pale brown, suberect setae. Head yellow, vertical, rounded at frons, with sparse, silky, suberect setae; basal transverse carina of vertex reduced. Antennae almost en-

tirely dark brown, densely pubescent; segment I bearing a few, brown, suberect bristles; lengths of segments I-IV: 0.40-0.44, 1.63-1.64, 1.20-1.36, 0.48-0.51. Rostrum pale brown, reaching hind coxa; apical part of segment IV darkened. Pronotum yellow or yellowish green, shining, with darkened posterior margin, bearing pale brown, suberect setae; mesoscutum and scutellum yellow, weakly pruinose, sparsely clothed with silky, suberect setae; thoracic pleurite widely yellow except for darkened posterior margin of propleuron. Hemelytra yellowish green, semitransparent, with uniformly distributed, pale brown suberect setae and sparse, short, silvery pubescence; inner margin of clavus narrowly darkened; membrane pale smoky brown, semitransparent, with a dark spot near posterior corner of vein. Legs long; femora yellowish brown, densely pubescent; trichobothria on fore- and middle femora brown, prominent; tibiae dark brown, with brown spines, tarsi entirely dark brown; lengths of hind femur, tibia and tarsus: 1.68, 2.85-2.88, 0.48; lengths of hind tarsomeres I-III: 0.12-0.15, 0.21-0.24, 0.20-0.23. Abdomen pale brown except for darkened parameres. Male genitalia (figs. 68-70): Genital segment uniformly provided with long, spine-like setae apically (fig. 68); left paramere broadened subapically, with blunt-tipped hypophysis (fig. 70); apical part of right paramere flattened, distinctly and roughly toothed (fig. 69).

Female: Unknown.

Dimensions. – ♂: Body length 4.17-4.28; head width including eyes 0.69-0.71; vertex width 0.27-0.29; rostral length 1.24-1.25; mesal pronotal length 0.55-0.56; basal pronotal width 1.03-1.06; width across hemelytra 1.27-1.28.

Distribution. – Japan (Honshu).

### *Cyllecoris* Hahn

*Cyllecoris* Hahn, 1834: 97, type species: *Cimex agilis* Fabricius, 1781, a synonym of *Cimex histronicus* Linnaeus, 1767, subsequent designation; Schuh 1995: 98.

Easily recognized by the slender, elongate body, shiny fuscous head, small eyes removed from anterior margin of the pronotum, long antennal segment I much longer than width of the head, and anteriorly constricted pronotum divided into two (anterior and posterior) lobes. Detailed diagnostic characters were provided by Wagner & Weber (1964), Wagner (1973), Josifov & Kerzhner (1984), etc. Many authors misspelled the generic name as *Cyllocoris*!

In Japan two deciduous broadleaf inhabiting species are currently known. They are considered to be wasp-mimic species as they behave like wasps when captured in insect nets.

### *Cyllecoris nakanishii* Miyamoto (figs. 74-75)

*Cyllecoris nakanishii* Miyamoto, 1969: 79; Miyamoto & Yasunaga 1989: 162; Kerzhner 1988b: 829; Schuh 1995: 99; Endo et al. 1998: 17.

Diagnosis. – Recognized by the slender body, yellowish brown antennal segment I, dark, shagreened, glabrous pronotum with a mesal pale stripe, sombre yellowish brown hemelytra with obscure stripes, and a dark, anterior stripe of each femur (fig. 74). Length 5.9-6.6; width 1.4-1.5. A detailed description including the male and female genitalia was provided by Miyamoto (1969). The final instar nymph is recognized by the slender body, whitish green general coloration, a dark stripe of each femur, and infusate apex of the abdomen (fig. 75).

Distribution. – Japan (Hokkaido), Kuril Isls., Russia (Sakhalin).

Biology. – This species is known to be associated with elms, *Ulmus japonica* Nakai and *Ulmus laciniata* (Trautv.) Mayr (Ulmaceae).

Material examined. – 42 specimens (HUES, ZMAS) were examined from the following localities: JAPAN: Hokkaido: Moshiri, Horokanai T., Kamikawa; Etanbetsu & Inoh, Asahikawa C., Kamikawa; Aoyama & Hattari, Tobetsu T., Ishikari; Hokkaido Univ. Campus, Sapporo C., Ishikari; Takaoka, Tomakomai C., Iburu; Berabonai-Takuhoku, Ashoro T., Tokachi. – KURIL ISLS.: Dubovoe, Kunashiri Is. (ZMAS) – RUSSIA: Novoaleksandrovsk, S. Sakhalin (ZMAS).

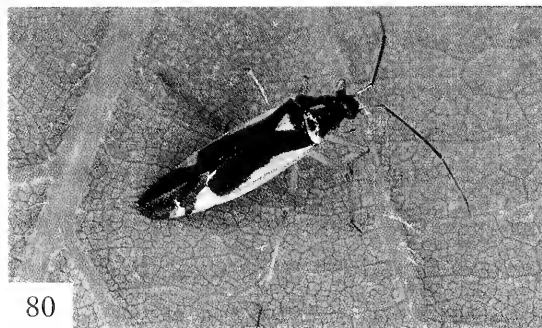
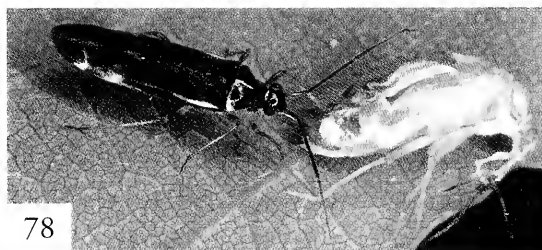
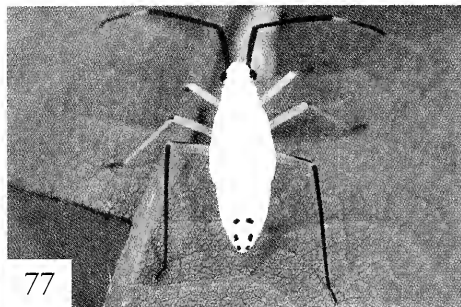
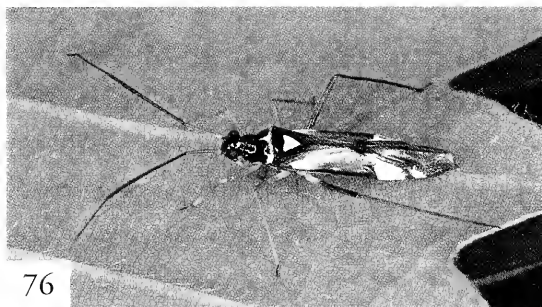
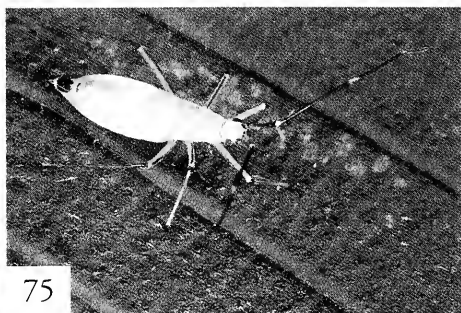
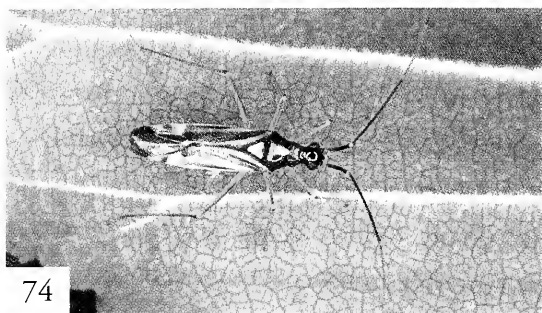
### *Cyllecoris vicarius* Kerzhner (figs. 76-77)

*Cyllecoris vicarius* Kerzhner, 1988a: 45; 1988b: 829; Miyamoto & Yasunaga 1989: 162; Josifov 1992: 122; Lee et al. 1994: 12; Schuh 1995: 100; Endo et al. 1998: 17. *Cyllecoris histronicus* sensu Miyamoto 1969: 82 (nec Linnaeus, 1767).

Diagnosis. – Easily recognized by the large size, reddish antennal segment I, shiny black pronotum with the continuously yellow posterior margin, and reddish corium (fig. 76). Length 7.0-7.5; width 1.9-2.0. Detailed description of the adult with figures of the male genitalia was provided by Kerzhner (1988a). The final instar nymph is easily recognized by the pure white general coloration, black antennal segment I and II, hind tibia and all tarsi, yellowish brown hind femur with a dark stripe, and 3 pairs of characteristic, dark, apical spots on the abdomen (fig. 77).

Distribution. – Japan (Hokkaido, Honshu, Shikoku, Kyushu), Kuril Isls., Russia (Primorsky Krai, Amur).

Biology. – This species is associated with *Quercus crispula* Blume (Fagaceae). The final instar nymphs and adults of this univoltine mirid are found in late June.



Figs. 74-81. Adults (74, 76, 78, 80) and final instar nymphs (75, 77, 79, 81) of *Cylloceria nakanishii* (74-75), *C. vicarius* (76-77), *Dryophilocoris saigusai* (78-79) and *D. miyamotoi* (80-81).

Material examined. – 26 specimens (HUES, ZMAS) were examined from the following localities: JAPAN: Hokkaido: Tokachi-Mitsumata, Kamishihoro T., Tokachi; Aoyama, Tobetsu T., Ishikari; Okusawa, Otaru C., Shiribeshi; Mt. Chisenupuri, 500–600 m alt., Niseko, Shiribeshi. – Honshu: Nagayasawa, Kuroishi C., Aomori Pref.; Kettou, Tsunan T., Niigata Pref.; Jonen-Mitsumata, Nagano Pref.; Uchiyama, Saku C., Nagano Pref. – Shikoku: Yosakoshi-toge, Hongawa Vil., Kochi Pref.; Befu, Monobe Vil., Kochi Pref.; Odamiyama, Ehime Pref. – RUSSIA: Ussurijsk, S. Primorskij Kraj (lectotype ♂, ZMAS); between Malaja Pera and Bolshaja Erageli Rivers, Amur Prov. (3 paralectotypes, ZMAS).

### *Dryophilocoris* Reuter

*Globiceps (Dryophilocoris)* Reuter, 1875a: 1: 90, type species: *Cyllecoris flavonotatus* Boheman, 1852, a synonym of *Cimex flavoquadrimaculatus* De Geer, 1773, monotypic. *Dryophilocoris* – Wagner 1952: 135; Schuh 1995: 104.

At first sight similar to *Cyllecoris*, *Dryophilocoris* is separable by the shorter head, eyes almost contiguous to the pronotum, basal transverse carina on the vertex, short antenna, always pruinose anterior lobe of the pronotum, and 3 sclerites of the vesica (figs. 85, 89, 93, sclerites I–III). Detailed diagnostic characters were provided by Wagner & Weber (1964), Wagner (1973), Josifov & Kerzhner (1984), etc.

This Palearctic genus is currently composed of 12 species that are deciduous broadleaf inhabitants. Most members occur in the temperate zone of the eastern Eurasia, and in Japan 3 *Quercus*-inhabiting species have been confirmed. They, without exception, have a univoltine life cycle, and the newly emerged adults appear from late spring to early summer.

### *Dryophilocoris saigusai* Miyamoto (figs. 78–79, 82–85)

*Dryophilocoris saigusai* Miyamoto, 1966: 431; Miyamoto & Yasunaga 1989; Schuh 1995: 105; Endo et al. 1998: 17.

Diagnosis. – Recognized by the elongate, principally fuscous body, distinctly pubescent pronotum with the pruinose calli and polished, transversely rugose posterior part, sometimes yellow scutellum in ♀, widely darkened mesial cuneus (fig. 78), widely excavated ventral apical part of the male genital segment, elongate left paramere (figs. 82–84), wide but short mesial branch of the vesical sclerite II, and smooth vesical sclerites I and III (fig. 85). Length 5.7–6.6; width 1.4–1.7. A detailed description including that of the male genitalia was provided by Miyamoto (1966). The final instar nymph is recognized by the pale green body, fuscous antenna, yellow posterior margin of the pronotum, yellow mesonotal wingpad with the infuscate inner part, a fuscous apical stripe on each femur, and dark extreme base of each tibia and dark tarsi (fig. 79).

Distribution. – Japan (Hokkaido, Honshu).

Biology. – Confirmed breeding host of this mirid is *Quercus crispula* Blume (Fagaceae), and the final instar nymph was found in early June. A just emerged adult of another mirid, *Castanopsides potanini* (Reuter) of the subfamily Mirinae, was observed as prey in the laboratory (fig. 78).

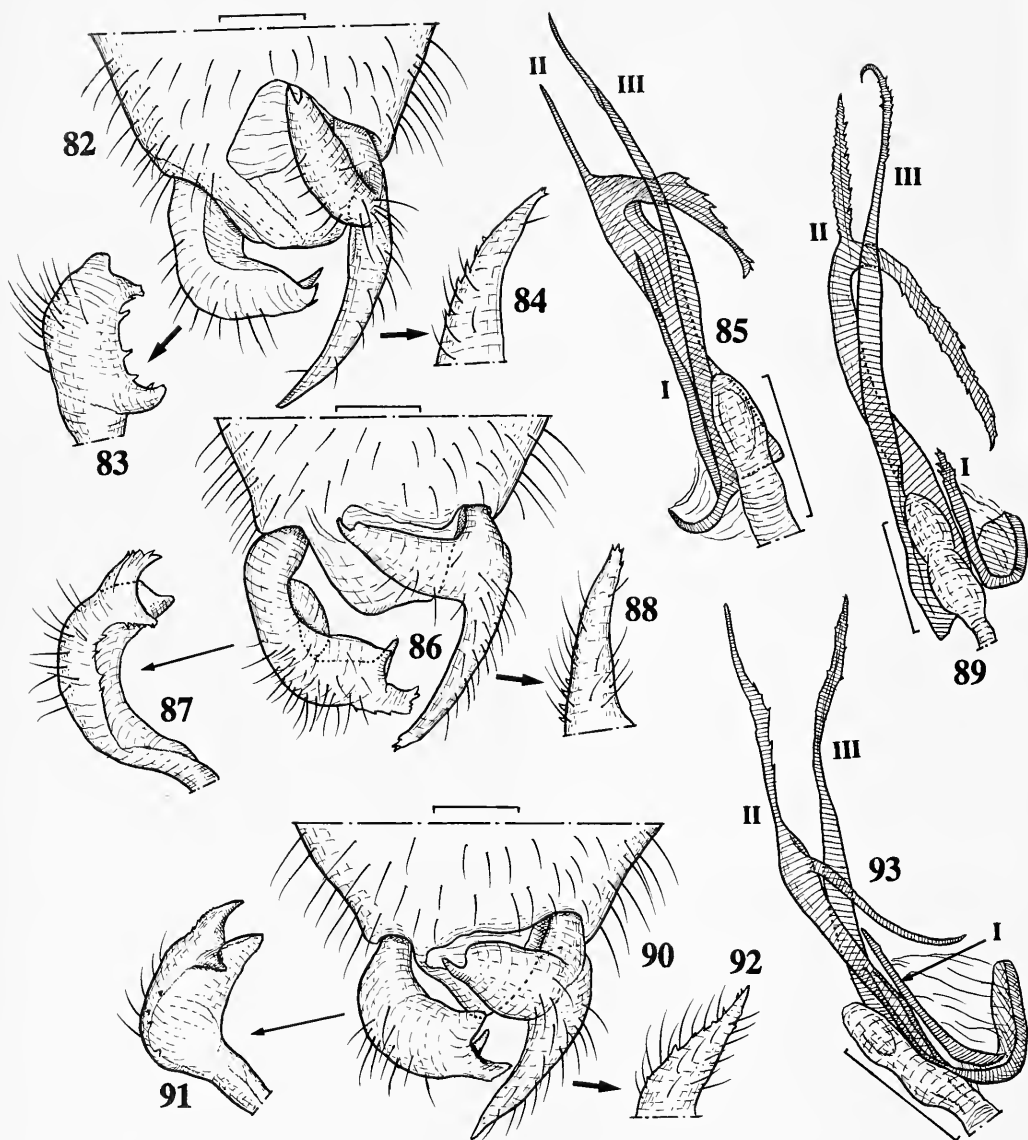
Material examined. – 13 specimens (HUES) were examined from the following localities in Japan: Hokkaido: Mt. Asahidake, 1,600–1,700 m, Higashikawa T., Kamikawa; Yumoto, Mt. Chisenupuri, Niseko, Shiribeshi; 4-ban River, Tobetsu T., Ishikari. – Honshu: Ohmachi-Aokiko, Nagano Pref.; Mt. Kakezu, Geihoku T., Hiroshima Pref.

### *Dryophilocoris lucidus* sp. n. (figs. 86–89)

Type material. – Holotype ♂, Mt. Gomadan, 1,300 m alt., Nara/Wakayama Pref., 7.vi.1997, T. Yasunaga (HUES). – Paratypes: 43 specimens (HUES) from the following localities in Japan: Honshu: Uchiyama, Saku C., Nagano Pref.; Gonbei-toge, Ina C., Nagano Pref.; Mt. Kiso-hakkai, 1,400–1,650 m alt., Nagano Pref.; Mt. Wasamata, Kamikitayama Vil., Nara Pref.; same as holotype; Hanazono, Mt. Koya, Wakayama Pref. – Kyushu: Bogatsuru, Mts. Kuju, Oita Pref.

Diagnosis. – Allied to the preceding one, this new species is easily distinguished by the very sparse dorsal vestiture and highly polished, glabrous, not wrinkled posterior lobe of the wider pronotum, in addition to significantly different structure of the vesica. *D. lucidus* is also related to *D. kanyukovae* Josifov & Kerzhner, 1984 from Korea and the Russian Primor'je, but the latter has the longer antenna, variable orange portions on the pronotum and scutellum, and smooth apex of the vesical sclerite I.

Description. – Body elongate, parallel-sided; dorsal surface dark chestnut brown, with very sparse pubescence. Head shiny fuscous, glabrous, with yellow, narrow basal transverse carina on vertex. Antenna dark brown, slender; lengths of segments I–IV (♂/♀): 0.60–0.65/0.63–0.65, 1.86–1.90/1.82–1.89, 0.98–1.08/0.95–0.99, 0.34–0.37/0.36–0.40. Rostrum yellowish brown, reaching apex of middle coxa; apical half of segment IV darkened. Pronotum dark chestnut brown, shiny and glabrous on posterior half, with yellow posterior angle, in \_ with a yellow, longitudinal, mesal stripe; calli dark greyish brown, pruinose, with sparse, silky pubescence; mesoscutum and scutellum dark greyish brown, shagreened, somewhat arched, transversely rugose; pleura widely greyish brown, pruinose, except for propleuron shiny dark brown. Hemelytra dark brown, weakly shagreened; anterolateral part of corium, and base and apex of



Figs. 82-93. Male genitalia of *Dryophilocoris* spp. – 82-85, *D. saigusai*; 86-89, *D. lucidus*; 90-93, *D. miyamotoi*. – 82, 86, 90, genital segment with parameres in ventral view; 83, 87, 91, right paramere; 84, 88, 92, sensory lobe of left paramere; 85, 89, 93, vesica. Scales: 0.2 mm.

cuneus narrowly ( $\delta$ ) or widely ( $\varphi$ ) yellow; embolium yellow; membrane dark greyish brown, with a pale spot along apex of cuneus. Coxae and legs yellow; femora somewhat reddish; tibial spines pale brown, short; tarsi brown, with darker tarsomeres III; lengths of hind femur, tibia and tarsus ( $\delta/\varphi$ ): 1.74-1.75/1.80-1.86, 2.72-2.78/2.53-2.78, 0.34-0.42/0.35-0.40; lengths of hind tarsomeres I-III ( $\delta/\varphi$ ): 0.13-0.15/0.15-0.17, 0.16-0.19/0.19-0.21, 0.24-0.25/0.23-0.25. Abdomen unicolorously dark chestnut brown. Male genitalia (figs. 86-89): Ventral surface of genital segment somewhat excavated apically (fig. 86); left paramere long; right paramere with apical toothed processes (fig. 87); vesical sclerite I short, toothed apically; mesial branch of sclerite II long; apex of sclerite III with hooked apex (fig. 89).

Dimensions. –  $\delta/\varphi$ : Body length 6.36-6.60/6.63-7.20; head width including eyes 0.81-0.83/0.80-0.83; vertex width 0.34-0.36/0.38-0.40; rostral length 1.26-1.30/1.34-1.38; mesal pronotal length 0.80-0.88/0.90-0.92; basal pronotal width 1.37-1.45/1.47-1.52; width across hemelytra 1.58-1.62/1.58-1.75.

Distribution. – Japan (Honshu, Kyushu).

Biology. – Most specimens of this new mirid were collected on *Quercus crispula*, which is considered to be the host plant, but nymphs have not been found yet. The newly emerged adults appear in early June.

*Dryophilocoris miyamotoi* sp. n.  
(figs. 80-81, 90-93)

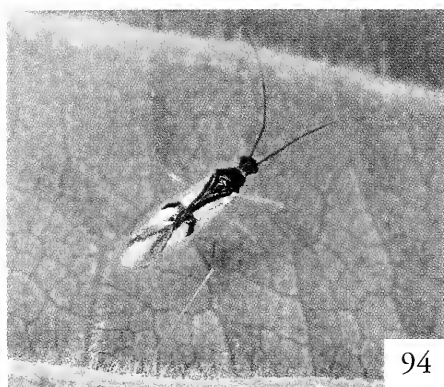
*Dryophilocoris* sp. – Hiranuma & Yasunaga 1998: 2 (descriptions of nymphs); Endo et al. 1998: 17.

Type material. – Holotype:  $\delta$ , Mt. Arashiyama, Asahikawa C., Kamikawa, Hokkaido, Japan, 30.v.1998, T. & M. Yasunaga (HUES). – Paratypes: 273 specimens (HUES) from the following localities of Japan: Hokkaido: Same as the holotype; Ishikari coast, Ishikari C.; 4-ban Riv. & Aoyama, Tobetsu T., Ishikari; Okusawa Reservoir, Otaru C., Shiribeshi; Shimo-Futamatazawa, Yoichi T., Shiribeshi; Ohnuma, Oshima. – Honshu: Kurokumano-taki, Ajigasawa T., Aomori Pref.; Higashiyama, Shinjo C., Yamagata Pref.; Mikura, Tsunan T., Niigata Pref.; Jonen-Mitsumata, Nagano Pref.; Kisojohara, Nagawa Vil., Nagano Pref.; Abo-toge, Azumi Vil., Nagano Pref.; Yoji, Ina C., Nagano Pref.; Kuzu hot spring, Nagano Pref.; Mt. Wasamata, Kami-kitayama Vil., Nara Pref.; Kusama, Niimi C., Okayama Pref.; Mt. Kakezu, Geihoku T., Hiroshima Pref. – Kyushu: Mt. Shiratori, 900-1,300 m, alt., Izumi Vil., Kumamoto Pref.; Chojabaru, Shirosukosen & Oike, Mts. Kuju, Oita Pref.

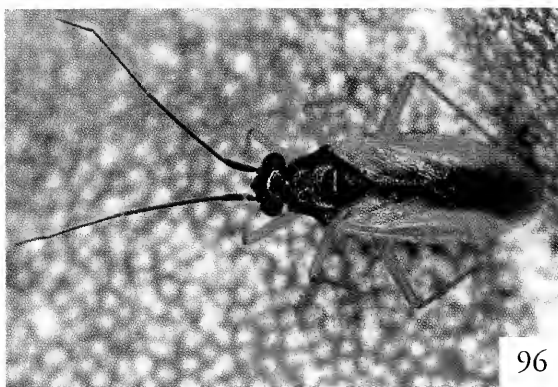
Diagnosis. – Easily recognized by the widely pruinose pronotum furnished with the densely distributed, suberect setae. The general coloration is variable. In the populations of southwestern Japan (west of the Kii Peninsula), the posterior half of the pronotum is more widely shagreened and provided with much sparsely distributed pubescence, and the pubescence on the hemelytra is also shorter and sparser. Since no significant differences are exhibited in the male genitalia, however, these forms are considered to represent zoogeographical variation. Every instar nymph was described and figured by Hiranuma & Yasunaga (1998) as *Dryophilocoris* sp. The final instar nymph of the present new species resembles that of *saigusai*, from which it can be distinguished by the yellowish green general coloration, pale antennae, orange apex of the mesonotal wingpad and entirely pale tibiae (fig. 81).

Description. – Body elongate, parallel-sided; dorsal surface densely clothed with silky, suberect pubescence. Head shiny dark brown, almost glabrous, with yellow basal transverse carina on vertex. Antenna brown; segment I usually yellowish brown; segment II dark brown, sometimes with paler base; lengths of segments I-IV ( $\delta/\varphi$ ): 0.52-0.62/0.53-0.61, 1.63-1.75/1.59-1.83, 0.79-0.97/0.93-1.07, 0.31-0.37/0.34-0.37. Posterior lobe of pronotum widely shagreened, pubescent, with a yellow, longitudinal, mesal stripe and yellow posterior margin; calli greyish brown, pruinose; mesoscutum dark greyish brown, pruinose, transversely rugose; scutellum yellow, transversely rugose, in  $\delta$  widely fuscous anteriorly; pleura widely greyish brown, pruinose; propleuron dark brown, with yellow margin. Hemelytra dark brown, somewhat shagreened, densely pubescent; embolium, basal 1/3-1/2 and apex of cuneus, and anterior or sometimes whole ( $\varphi$ ) lateral margin of corium yellow (fig. 80); membrane dark greyish brown, with apical parts of veins and a spot along apex of cuneus pale. Coxae and legs yellow; apical parts of femora sometimes tinged with orange brown; tibial spines pale brown, short; tarsi brown, with darker tarsomeres III; lengths of hind femur, tibia and tarsus ( $\delta/\varphi$ ): 1.58-1.68/1.52-1.73, 2.50-2.65/2.21-2.68, 0.31-0.37/0.31-0.37; lengths of hind tarsomeres I-III ( $\delta/\varphi$ ): 0.14-0.19/0.15-0.18, 0.15-0.19/0.17-0.19, 0.18-0.25/0.18-0.24. Abdomen unicolorously dark brown. Male genitalia (figs. 90-93): Ventral surface of genital segment not strongly excavated at apex (fig. 90); left paramere short (fig. 90, 92); apical part of right paramere with two pointed processes (fig. 91); mesial branch of vesical sclerite II smooth (fig. 93).

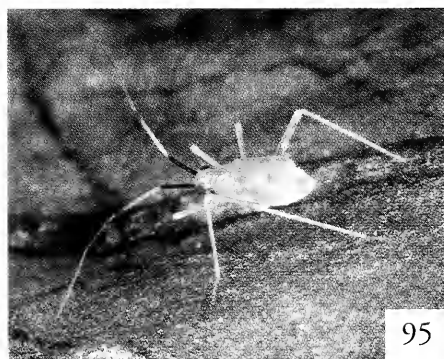
Dimensions. –  $\delta/\varphi$ : Body length 6.30-6.84/6.30-6.90; head width including eyes 0.79-0.83/0.79-0.84; vertex width 0.34-0.40/0.39-0.43; rostral



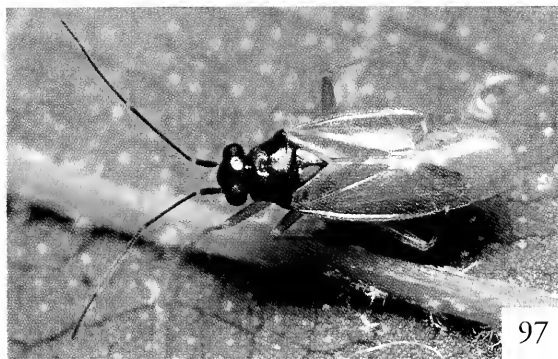
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96



95



97

Figs. 94-97. Adults (94, 96, 97) and final instar nymph (95) of *Mecomopsis cruciata* (94-95), *Cyrtorhinus caricis* (96) and *C. lividipennis* (97).

length 1.26-1.43/1.31-1.41; mesal pronotal length 0.78-0.83/0.79-0.94; basal pronotal width 1.37-1.43/1.42-1.56; width across hemelytra 1.47-1.64/1.64-1.75.

Distribution. – Japan (Hokkaido, Honshu, Shikoku, Kyushu).

Biology. – Confirmed breeding hosts of this new species are fagaceous *Quercus crispula* Blume and *Quercus dentata* Thunb. et Murray. This mirid has a univoltine life cycle, and emerges in late May in Kyushu and in early June in Hokkaido. The nymphs are predominantly found on the flowers, and exhibit cryptic coloration harmonious with the flowers (fig. 81).

### *Mecomma* Fieber

*Mecomma* Fieber, 1858: 313, type species: *Capsus ambulans* Fallén, 1807, monotypic; Schuh 1995: 142.

Recognized by the moderate size, short and anteriorly flattened head, small eye almost contiguous to pronotum, short antenna, whitish, semitransparent and partly infusate hemelytra, somewhat twisted left

paramere, mesial flat process of right paramere, and simple and apically branched vesical appendage. The female adults are often brachypterous. Detailed diagnostic characters were provided by Wagner & Weber (1964), Wagner (1973), etc.

*Mecomma* contains about 30 species in the Holarctic Region and Old World tropics. Only one species is currently known from Japan.

### *Mecomma japonica* Miyamoto (figs. 98-100)

*Mecomma japonica* Miyamoto, 1966: 429; Miyamoto & Yasunaga 1989: 162; Schuh 1995: 144.

Diagnosis. – Recognized by the characters as mentioned in generic diagnosis, rather large size, fuscous head, pronotum and scutellum, widely infusate inner part of the clavus, dark apical inner margins of the corium and cuneus, small, pointed teeth on the apical part of the right paramere (fig. 99), and 3-branched apex of the vesical appendage (fig. 100). Length 5.3-5.4; width 1.7-1.8 (♂). A de-

tailed description of the male with figures of the dorsal habitus and genitalia was provided by Miyamoto (1966). The fuscous, brachypterous female was recently discovered during examining unsorted collections of NIAS and NSMT, and are described below for the first time.

**Description.** – Female: Brachypterous. Body black, ovoid, with widened abdomen; dorsal surface shagreened, with uniformly distributed, simple, silky pubescence. Head vertical, slightly narrower than pronotum; vertex with a pair of pale spots along inner margin of eyes. Antenna dark brown, slightly longer than body; segment I, basal 1/4-1/2 of II and basal 1/3-1/2 of III yellowish brown; segment II slightly incrassate towards apex; lengths of segments I-IV: 0.40-0.41, 1.15-1.20, 1.03-1.10, 0.46-0.56. Rostrum pale brown, nearly reaching apex of hind coxa; segment I and apical part of IV darkened. Pronotum with weak, pruinose collar and somewhat tumid calli; pleura dark greyish brown. Hemelytra simple in form, noticeably shortened, lacking membrane and distinct veins, with rounded apex that is not exceeding abdominal segment VI. Legs yellowish brown, slightly tinged with red; tarsi pale brown, with darker tarsomeres III; lengths of hind femur, tibia and tarsus: 1.42-1.46, 2.10-2.15, 0.54-0.59; lengths of hind tarsomeres I-III: 0.15-0.18, 0.25-0.32, 0.24-0.25. Abdomen shiny fuscous, wider than hemelytra.

**Dimensions.** – ♀: Body length 2.89-3.23; head width including eyes 0.85-0.90; vertex width 0.37-0.39; rostral length 1.50-1.52; mesal pronotal length 0.46-0.50; basal pronotal width 0.90-0.95; width across hemelytra 1.45-1.50; maximum width across abdomen 1.59-1.86.

**Distribution.** – Japan (alpine areas of north and central Honshu).

**Material examined.** – Honshu: 1♂, Mt. Senjo-dake, Nagano Pref., 7.viii.1961, T. Saigusa (holotype, MC); 2♂, Tokusawa, Japan Alps, Nagano Pref., 6.viii.1955, Y. Utsugi (NIAS); 2♀, Mt. Chokai, Yamagata Pref., 17.ix.1971, M. Tomokuni (NSMT); 2♀, Mt. Norikura, Nagano Pref., 7.ix.1951, H. Hasegawa (NIAS).

### *Mecommopsis* Kerzhner, 1979

*Mecommopsis* Kerzhner, 1979: 39, type species: *M. cruciata* Kerzhner, 1979, monotypic; Schuh 1995: 145.

This monotypic genus is easily recognized by the slender body, small eyes removed from the anterior margin of the pronotum, very long antennal segment I even longer than pronotal width, distinct pronotal collar, delicate hemelytra much longer than abdomen, long legs, slender, elongate left paramere (fig. 101), a mesial thumb-like process of right paramere (fig. 102),

and membranous vesica with the bifurcate apical sclerite (fig. 103). These characters enable us to distinguish it from the related genus, *Mecomma* Fieber.

### *Mecommopsis cruciata* Kerzhner

(figs. 94-95, 101-103)

*Mecommopsis cruciata* Kerzhner, 1979: 39; 1988b: 831; Miyamoto 1988: 638; Miyamoto & Yasunaga 1989: 162; Josifov 1992: 122; Lee et al. 1994: 12; Schuh 1995: 145.

**Diagnosis.** – Recognized by the characters as mentioned in generic diagnosis, shiny black head, pronotum and scutellum, whitish green pronotal collar, and semitransparent hemelytra with the anchor-shaped mesial black marking and fuscous clavus (fig. 94). Length 4.3-5.0; width 1.2-1.3. A redescription is not provided here as Kerzhner (1979) provided a detailed description with figures of the dorsal habitus and male genitalia, and the identity is clear. The final instar nymphs were discovered in July, 1998, and are readily recognized by the entirely whitish green, oval body, conspicuously long, slender antenna and leg, and contrastingly fuscous antennal segment I (fig. 95).

**Distribution.** – Japan (Hokkaido, Honshu, Kyushu\*), S. Kuril Isls., Russia (Primorskij Kraj and Sakhalin), Korea.

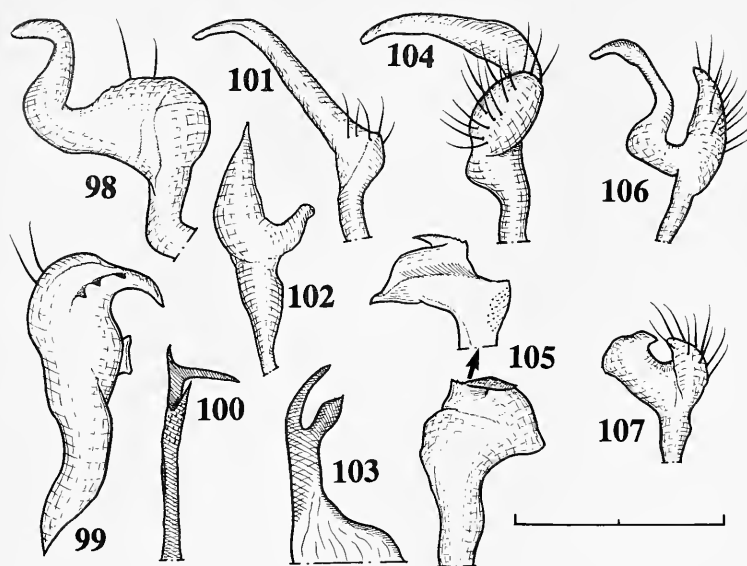
**Biology.** – Confirmed breeding host is *Ligularia* sp. (Compositae). Both adults and nymphs of this univoltine mirid are found on underside of the large, rounded leaves from mid July to early August.

**Material examined.** – 106 specimens (HUES, NSMT, USNM, ZMAS) were examined from the following localities: JAPAN: Hokkaido: Moshiri, Horokanai T., Kamikawa; Etanbetsu, Asahikawa C., Kamikawa; Mt. Asahidake, 200-800 m alt., Mts. Taisetsu, Kamikawa. – Honshu: Japan Alps, Nagano Pref. – Kyushu: Mt. Shiratori, 1,100-1,300 m alt., Izumi Vil., Kumamoto Pref. (USNM) – KURIL ISLS.: Tret'jakovo, Kunashiri Is. (holotype & paratypes, ZMAS). – RUSSIA, Primorskij Kraj: Ussurijsk Nature Reserve; Rjazanovka, Khasanskij Dist.

### *Cyrtorhinus* Fieber

*Cyrtorhinus* Fieber, 1858: 313, type species: *Capsus elegantulus* Meyer-Dür, 1843, a synonym of *Capsus caricis* Fallén, monotypic; Schuh 1995: 100.

This is a small genus composed of 11 species. Most members are distributed in the Old World tropics and subtropics, and Pacific islands. The genus is recognized by the small size, elongate oval body, short head, darkened pronotum, pale hemelytra, developed sensory lobe of the left paramere, apically widened right paramere, and simple form of the vesica. It is liable to be confused with *Tyrtus* Fieber, 1864 of the



Figs. 98-107.

Male genitalia of *Mecomma japonica* (98-100), *Mecomopsis cruciata* (101-103), *Cyrtorhinus caricis* (104-105) and *C. lividipennis* (106-107). — 98, 101, 104, 106, left paramere; 99, 102, 105, 107, right paramere; 100, 103, vesical sclerotized appendage. Scale: 0.2 mm.

subfamily Phylinae, from which *Cyrtorhinus* is separable by the fleshy, apically convergent parempodia between the claws. Many authors have been liable to misspell the generic name as *Cyrtorrhinus*!

Species of *Cyrtorhinus* are predominantly predaceous, and some are known to feed preferably on eggs of delphacid leafhoppers.

*Cyrtorhinus caricis* (Fallén)  
(figs. 96, 104-105)

*Capsus caricis* Fallén, 1807: 102.

*Cyrtorhinus caricis* — Carvalho 1958: 54; Wagner & Weber 1964: 336; Wagner 1973: 258; Kerzhner 1988b: 831; Miyamoto & Yasunaga 1989: 162; Lee & Kwon 1991: 33; Schuh 1995: 100.

**Diagnosis.** — Recognized by the dark head, a pair of pale, lateral spots on the vertex, entirely fuscous pronotum and scutellum, pale green and mesally infuscate hemelytra (fig. 96), bulbous sensory lobe of the left paramere (fig. 104), and a hook-shaped apical process of the right paramere (fig. 105). Length 3.3-4.2; width 1.2-1.5. Redescriptions or diagnostic characters were provided by Wagner & Weber (1964), Wagner (1973), Kerzhner (1988b), etc.

**Distribution.** — Japan (Hokkaido, N. Honshu), Holarctic Region.

**Biology.** — As mentioned by Wheeler & Henry (1992), this mirid was found on sedges (*Carex* spp. of the Cyperaceae) in northern Japan.

**Material examined.** — 22 specimens (BMNH, HUES, ZMUH) were examined from the following localities: JAPAN: Pashikuru-numa, Onbetsu T., Hokkaido; Obuchi-numa & Noushi-numa, Aomori Pref., N. Honshu — FINLAND: Alandia (BMNH). — SWEDEN: Huddinge, pr. Stockholm (ZMUH). — CANADA: Come-by-chance, SE. Newfoundland (ZMUH); Grand Falls, C. Newfoundland (ZMUH).

*Cyrtorhinus lividipennis* Reuter  
(figs. 97, 106-107)

*Cyrtorhinus lividipennis* Reuter, 1885: 199; Carvalho 1956: 57; Miyamoto & Yasunaga 1989: 162; Lee & Kwon 1991: 33; Yasunaga et al. 1993: 149; Schuh 1995: 101.

**Diagnosis.** — Recognized by the small size, fuscous pronotum with pale anterior part, pale scutellum with a dark, longitudinal, mesal stripe, wholly pale green hemelytra (fig. 96), long protuberance of the left paramere (fig. 106), and broad, bifurcate apical part of the right paramere (fig. 107). Length: 2.6-3.5; width 0.9-1.3. A detailed redescription was provided by Carvalho (1956), and the ovariole number and structure of the alimentary organs were documented by Miyamoto (1957, 1961). Having similar general appearance, habit and habitat, this species is sometimes confused with *Tytthus chinensis* (Stål) of the Phylinae, from which *C. lividipennis* is separable by the pale anterior half of the pronotum, greenish hemelytra, and distinct, fleshy, apically convergent parempodia between the claws.

**Distribution.** — Japan (Honshu, Shikoku, Kyushu,

Ryukyu Isls.), Taiwan, S. China, Oriental Region, Micronesia.

**Biology.** – This is a well known, economically important predator preying on eggs of delphacid leafhoppers injurious to rice (*Oryza sativa* L. of the Gramineae). Zhang (1985) documented that an individual of *C. lividipennis* can feed on 170–230 delphacid eggs during lifetime. In southern Japan, this mirid is common in paddy fields, and appears to have two or more generations per year. Some delphacid species are known to migrate from continental China to Japan proper across the East China Sea. *C. lividipennis* has been captured together with delphacid leafhoppers on a ship on the East China Sea (see below), so that some of Japanese populations of this mirid appear to migrate from China.

**Material examined.** – 53 specimens (BMNH, HUES, NIAS) were examined from the following localities: JAPAN: Honshu: Saka'ashi, Nachi-Katsu'ura, Wakayama Pref. – Shikoku: Mt. Tsukimi, Yasu T., Kochi Pref.; Nishikuma, Monobe Vil., Kochi Pref.; Kitou Vil., Tokushima Pref. – Kyushu: Momiki, Izumi Vil., Kumamoto Pref.; Nameshi, Nagasaki C.; East China Sea (on Ship), 129°27'E, 32°15'N, about 70 km off the Nomozaki T., Nagasaki Pref. (NIAS) – Ryukyus: Yona, Kunigami Vil., Okinawa Is.; Omoto & Takeda, Ishigaki Is. – PHILIPPINES: Iloilo, Panay Is., Visayas – INDONESIA: Tomohan, Minahasa Pen., N. Sulawesi (Celebes) (BMNH). – MALAYSIA: Bukit Larut, 1,130 m alt., Taiping, Perak – INDIA: Madurai (BMNH) – FIJI: Naduruloulou (BMNH).

### *Zanchius* Distant

*Zanchius* Distant, 1904: 477, type species: *Z. annulatus* Distant, 1904, monotypic; Schuh 1995: 204.

This genus is easily recognized by the pale green general coloration, vertical head, projected frons, anteriorly situated eyes that are distinctly removed from the anterior margin of the pronotum, wide mesoscutum, and delicate, relatively wide and laterally rounded hemelytra. Redescriptions were provided by Linnavuori (1994), Schuh (1974) and Wagner (1973).

*Zanchius* comprises 30 species in the Old World and Pacific Islands, and 12 species have been reported from the regions adjacent to Japan (Carvalho 1956; Poppius 1915; Zheng & Liang 1991; Zheng & Liu 1993; Zou 1987a, 1989). In Japan, only a single species has been known, but 5 new species are added to the Japanese fauna in this paper.

Two monotypic genera, *Zonodoropsis* and *Itacorides*, were proposed for Taiwanese species by Poppius (1915) and Miyamoto (1965), respectively. Judging from the original descriptions, these genera are suspected to be synonymous with *Zanchius*. Since I have not examined the type species of the genera (*Zonodoropsis pallens* Poppius and *Itacorides shirozui* Miyamo-

to), however, I refrain from synonymizing them here.

The majority of *Zanchius* species appears to be associated with broadleaf host plants, whereas predation on persimmon leafhoppers by some *Zanchius* species was observed in China (Zheng & Liang 1991).

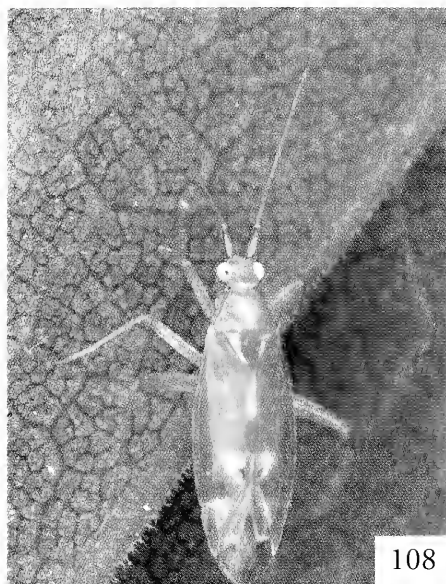
### *Zanchius tarasovi* Kerzhner (figs. 108–110, 115–118)

*Zanchius tarasovi* Kerzhner, 1988a: 49; 1988b: 832; Schuh 1995: 206; Hayashi & Higashikawa 1997: 39; Endo et al. 1998: 17.

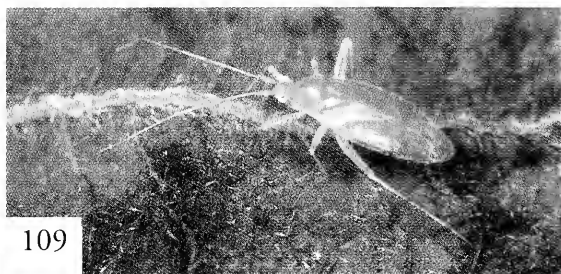
**Diagnosis.** – Recognized by the largest body among its Japanese congeners, long antennae, strongly curved left paramere, small apical process on the right paramere, and distinctly toothed vesical sclerite I. The final instar nymph is recognized by the oval body, unique head structure, and long antennae and legs (fig. 110).

**Redescription.** – Body pale green, elongate oval; dorsal surface uniformly clothed with pale, suberect pubescence. Head with a lateral short stripe behind each eye, vertical, bearing sparse, suberect, silky pubescence; vertex mesally with a basal transverse carina; frons weakly and roundly projected; tylus raised, visible in dorsal aspect. Antennae pale brown, somewhat tinged with red, slightly shorter than body; segment I usually with a sanguineous stripe laterally, bearing several brown bristles; lengths of segments I–IV ( $\delta/\eta$ ): 0.48/0.48–0.51, 1.96–2.02/1.96–2.21, 1.12–1.20/1.12–1.28, 0.69–0.75/0.72–0.75. Rostrum pale brown, long, reaching hind coxa; apex of segment IV darkened. Pronotum shining, with a short, longitudinal mesal sulcus between calli; mesoscutum and scutellum shining, with pale, suberect pubescence; posterior part of scutellum sometimes with sanguineous mark (fig. 108). Hemelytra pale green, subhyaline, very finely punctate, uniformly clothed with pale, suberect pubescence; apex of clavus and apical inner part of corium sometimes sanguineous; membrane pale brown, semitransparent. Legs generally pale green, sometimes partly tinged with red; tibial spines pale brown; lengths of hind femur, tibia and tarsus ( $\delta/\eta$ ): 1.65–1.76/1.77–1.92, 2.52–2.64/2.64–2.86, 0.40–0.41/0.40–0.44; lengths of hind tarsomeres I–III ( $\delta/\eta$ ): 0.12–0.14/0.13–0.16, 0.18–0.20/0.16–0.18, 0.19–0.21/0.15–0.18. Abdomen uniformly pale green. Male genitalia (figs. 115–118): Left paramere strongly curved at middle, twisted basally (fig. 116); right paramere with a median pointed projection and a small apical process (fig. 115); vesical sclerite I broad, with many teeth (fig. 118); sclerite II broadened; sclerite III gradually tapered towards apex (fig. 117).

**Dimensions.** –  $\delta/\eta$ : Body length 4.56–4.73/4.70–



108



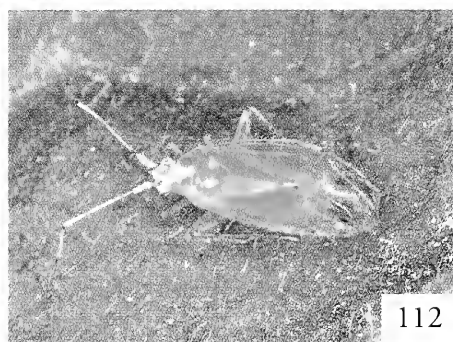
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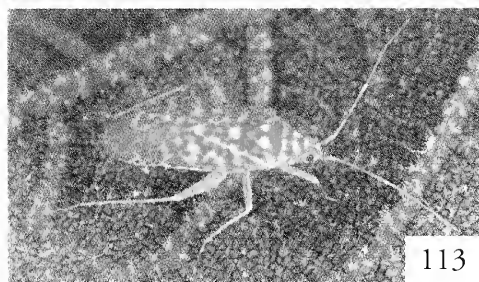
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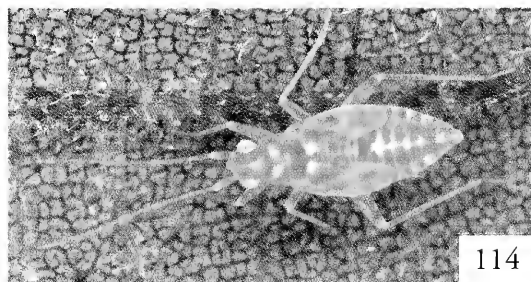
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112



113



114

Figs. 108-114. Adults (108, 109., 111-113) and final instar nymphs (110, 114) of *Zanchius tarasovi* (108-110), *Z. ryukyensis* (111), *Z. takahashii* (112) and *Malacocorisella endoi* (113-114).

5.00; head width including eyes 0.73-0.75/0.74-0.75; vertex width 0.33-0.34/0.36; rostral length 1.44-1.47/1.44-1.49; mesal pronotal length 0.52-0.53/0.57-0.58; basal pronotal width 1.05-1.08/1.05-1.16; width across hemelytra 1.63-1.66/1.72-1.73.

Distribution. – Japan (Hokkaido, Honshu, Shikoku), Russia (S. Primorskij Kraj), China (Hebei Prov.). This species has the northernmost distribution among its congeners.

Biology. – As reported by Endo et al. (1998), this mirid is found on many kinds of deciduous broad-leaved trees, such as *Juglans ailantifolia* Carr. (Juglandaceae), *Tilia japonica* (Miq.) Simonkai (Tiliaceae), *Quercus crispula* Blume, *Alnus* spp. and *Salix* spp. Both adults and nymphs of this mirid were observed to have preyed on a leafhopper injurious to persimmon in China (Zheng & Liang 1991). In Japan *Z. tarasovi* is often captured together with many typhlocybinid leafhoppers, so that it seems to be predominantly predaceous.

Material examined. – More than 200 specimens (HUES, IC, ZMAS) from the following localities: JAPAN: Hokkaido: Moshiri-Shirakaba, Horokanai T., Kamikawa; Hattari, Atsuta Vil., Ishikari; Aoyama, Tobetsu T., Ishikari; Hokkaido University Campus, Sapporo C., Ishikari; Berabonai-Takuhoku, Ashoro T., Tokachi; Kohnomai (Yakiyamano-sawa), Monbetsu C., Abashiri; Kanehana, Rubeshibe T., Abashiri. – Honshu: Sakaimatsu, Kuroishi C., Aomori Pref. (IC); Washirozawa, Kawauchi T., Aomori Pref. (IC); Shimoyu, Aomori C., Aomori Pref. (IC); Sugadaira, 1,330 m alt., Nagano Pref. – Shikoku: Mt. Tsurugi, Tokushima Pref.; Teragawa, Hongawa Vil., Kochi Pref.; Sameura, Yukimigawa & Tatsuno, Motoyama T., Kochi Pref. – RUSSIA, Primorskij Kraj: Kievka, Sudzukhinskij (currently Lazovskij) Nature Reserve (lectotype, ZMAS); Kedrovaja Pad', Khasanskij Dist. (3 paralectotypes, ZMAS); Vitjaz', 15 km S. of Sukhanovki, Khasanskij Dist. (3 paralectotypes, ZMAS).

*Zanchius quercicola* sp. n.  
(figs. 119-123)

Type material. – Holotype ♂, Same'ura, Motoyama T., Kochi Pref., Shikoku, Japan, ex *Quercus acutissima*, 24.vii.1996, Y. Nakatani (HUES). – Paratype: 1♂, Shiramizu, Shounai T., Oita Pref., Kyushu, 27-28.vii.1995, light trap, Y. Nakatani (HUES).

Diagnosis. – Recognized by the small size, clear scarlet lateral stripe of the antennal segment I, sparse vestiture on the hemelytra, smooth apex of the right paramere, weakly curved and basally widened left paramere, and less toothed vesical sclerite I. This new species is a close relative of *Z. tarasovi*, from which it can be distinguished by the significantly smaller body, sparse dorsal vestiture, less projected tylus, shorter antennae and legs, and different structure of the male genitalia.

Description. – Male: Body generally pale green, small, suboval; dorsal surface sparsely clothed with pale pubescence. Head with a scarlet lateral stripe behind each eye, vertical, bearing sparse, silky, suberect pubescence; vertex with a basal transverse carina; frons roundly produced; tylus raised but invisible in dorsal view. Antennae pale brown, somewhat tinged with red; segment I with a clear scarlet lateral stripe and an apical inner spot, bearing several pale, erect bristles; lengths of segments I-IV: 0.43-0.46, 1.82-1.85, 0.96-1.01, 0.62-0.72. Rostrum pale brown, long, slightly exceeding apex of hind coxa; apex of segment IV brown. Pronotum shining, rather short, with a weak, longitudinal mesal sulcus between calli, sparsely clothed with silky pubescence; mesoscutum and scutellum weakly pruinose, almost glabrous. Hemelytra uniformly pale green, semitransparent, with sparsely distributed, silky pubescence. Legs pale green; tibial spines pale brown; apical part of tarsomeres III darkened; lengths of hind femur, tibia and tarsus: 1.56-1.65, 2.28-2.40, 0.36-0.41; lengths of hind tarsomeres I-III: 0.12, 0.18-0.21, 0.15-0.18. Abdomen entirely pale green. Male genitalia (figs. 119-122): Genital segment with a squared, flat projection (fig. 119); left paramere not strongly curved, with flattened basal part (fig. 121); right paramere smooth apically, lacking apical process (fig. 120); vesical sclerites generally slender (fig. 122); sclerite I less toothed (fig. 123). Female: Unknown.

Dimensions. – ♂: Body length 3.84-3.96; head width including eyes 0.69-0.77; vertex width 0.30-0.32; rostral length 1.29-1.32; mesal pronotal length 0.49-0.53; basal pronotal width 1.00-1.08; width across hemelytra 1.44-1.49.

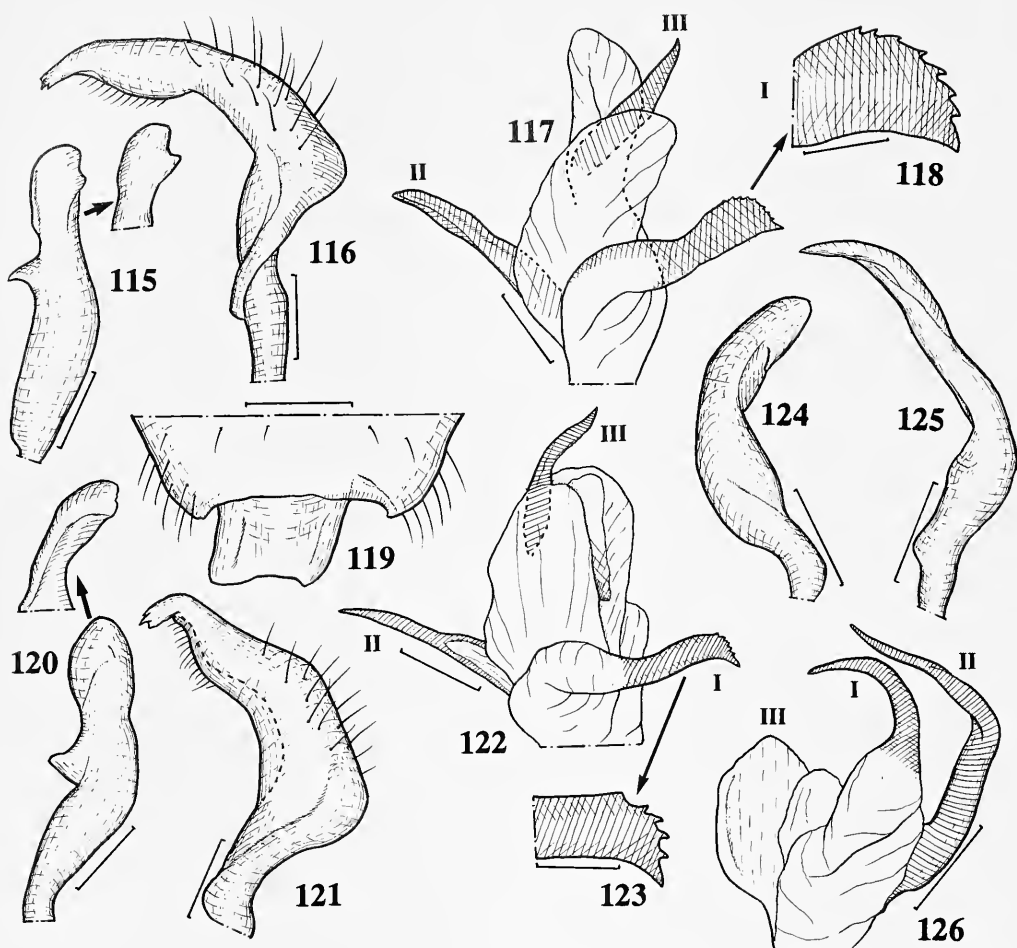
Distribution. – Japan (Shikoku, Kyushu).

Biology. – This new mirid appears to be associated with the oak, *Quercus acutissima* Carruthers.

*Zanchius ryukyusensis* sp. n.  
(figs. 111, 124-126)

Type material. – Holotype ♂, Yona, Kunigami Vil., Okinawa Is., the Ryukyus, Japan, 20-25.v.1993, light trap, Y. Nakatani (HUES). – Paratypes: 45 specimens (HUES) from the following localities of the Ryukyus, Japan: Okinawa Is.: Same as holotype; Benoki, Kunigami Vil.; Iji; Nanbu-Chinen; Gesashi, Higashi Vil. – Ishigaki Is.: Shiramizu. – Iriomote Is.: Monbanare nr. Otomi.

Diagnosis. – Recognized by the tiny size, dark brown annulations on the antennae, pale green hemelytra irregularly mottled with the green markings, and unique shape of the male genitalia. This new species is allied to *Z. zoui* described on a single female from Yunnan, China by Zheng & Liu (1993), but



Figs. 115-126. Male genitalia of *Zanchius* spp. – 115-118, *Z. tarasovi*; 119-123, *Z. quercicola*; 124-126, *Z. ryukyuensis*. – 115, 120, 124, right paramere; 116, 121, 125, left paramere; 117, 122, 126, vesica; 118, 123, apex of vesical sclerite I; 119, genital segment in ventral view. Scales: 0.2 mm for 119, 0.1 mm for 105-117, 120-122, 124-126, 0.05 mm for 118, 123.

*ryukyuensis* can be distinguished by the eyes much removed from the pronotum, shorter antenna, longer pronotum, and wholly pale femora. The final instar nymph of *ryukyuensis* is recognized by the entirely pure pale green, slender body. Description. – Body pale green, small, oblong oval; dorsal surface uniformly clothed with silky, suberect pubescence. Head vertical, with sparse, silky, erect pubescence; vertex with a pair of oval depressions anteriorly, margined by narrow but distinct basal transverse carina; frons rounded; tylus invisible in dorsal view. Antennae yellowish brown; segment I with a dark brown lateral stripe connected with dark apical ring; segment II

with two dark brown bands at basal 1/3 and apical 1/3; base of segment III darkened; lengths of segments I-IV ( $\delta/\varnothing$ ): 0.33-0.34/0.34-0.36, 1.27-1.37/1.22-1.32, 0.74-0.77/0.76-0.77, 0.72/0.74-0.77. Rostrum pale brown, exceeding apex of hind coxa. Pronotum shining, weakly pruinose, clothed with silky, suberect pubescence; mesoscutum and scutellum rather flat, weakly shagreened, sparsely clothed with silky, suberect pubescence. Hemelytra pale green, subhyaline, weakly shagreened, irregularly speckled with green markings, bearing sparse, silky pubescence; membrane pale brown, semitransparent, with green cells. Legs almost entirely pale green; tibial

spines pale brown; lengths of hind femur, tibia and tarsus ( $\delta/\eta$ ): 1.20/1.36-1.42, 1.92-2.00/2.06-2.14, 0.40-0.44/0.40-0.45; lengths of hind tarsomeres I-III ( $\delta/\eta$ ): 0.10-0.12/0.10-0.14, 0.19-0.22/0.16-0.21, 0.19-0.22/0.19-0.21. Abdomen generally pale green. Male genitalia (figs. 124-126): Left paramere long, slender, curved near its base, with tapered apex (fig. 125); right paramere blunt-tipped, roundly curved at middle (fig. 124); vesical sclerite I hooked, not toothed; sclerite II elongate, curved at middle; sclerite III reduced, becoming a flattened, weakly sclerotized plate (fig. 126).

Dimensions. –  $\delta/\eta$ : Body length 3.16-3.41/3.48-3.60; head width including eyes 0.57-0.63/0.57-0.60; vertex width 0.24-0.27/0.27-0.29; rostral length 1.24-1.25/1.41-1.44; mesal pronotal length 0.40-0.41/0.38-0.44; basal pronotal width 0.86-0.89/0.84-0.89; width across hemelytra 1.12-1.23/1.20-1.25.

Distribution. – Japan (the Ryukyus: Okinawa, Ishigaki and Iriomote Isls.).

Biology. – The collection records suggest that *Z. ryukyuensis* has two or more generations per year; newly emerged adults were collected in March, May and November. Both adults and nymphs of this new species were found on *Macaranga tanarius* (L.) Muell. Arg. (Euphorbiaceae) together with a typhlocybinid leafhopper, *Davmata* (or *Tautoneura*) sp. (Cicadellidae, Typhlocybinae) that is considered as prey.

#### *Zanchius nakatanii* sp. n.

Type material. – Holotype  $\eta$ , Yona, Kunigami Vil., Okinawa Is., the Ryukyus, Japan, 20-25.vii.1993, light trap, Y. Nakatani (HUES). – Paratypes (HUES): 4  $\eta$ , same data as for holotype; 1  $\eta$ , Naze C., Amami-Oshima Is., Ryukyus, 17.v.1999, K. Takahashi.

Diagnosis. – Easily recognized by the distinct dark setae on dorsum, subtriangularly projected frons, two sanguineous bands on the antennal segment II, dark brown base of the antennal segment III, and many green circular spots on the hemelytra. These characters enable us to distinguish this new species from other congeners.

Description. – Female: Body pale green, oblong-oval; dorsal surface provided with silky, suberect pubescence and distinct, dark, erect setae. Head somewhat pruinose, vertical, with silky, erect pubescence; vertex with a distinct, basal transverse carina; frons tumid, subtriangularly projected; tylus raised, almost equal in height to frons. Antennae yellow; segment I tinged with red laterally; segment II with two sanguineous bands at middle and base; base of segment III dark brown; lengths of segments I-IV: 0.33-0.36,

0.96-1.01, 0.55-0.60, 0.55-0.56. Rostrum pale brown, reaching or slightly exceeding apex of hind coxa. Pronotum weakly pruinose, somewhat carinate laterally, sparsely clothed with dark, erect setae and silky pubescence; calli weak; mesoscutum rather flat, bearing several, silky setae; scutellum provided with dark, erect setae. Hemelytra pale green, somewhat shagreened, semitransparent, with many green circular spots on clavus and corium, bearing dark, erect setae and silky, suberect pubescence; clavus without dark setae; cuneus narrowly margined by basal green band, lacking dark setae; membrane pale brown, semitransparent, with partly green veins and cells. Legs entirely pale brown; lengths of hind femur, tibia and tarsus: 0.98-1.13, 1.65-1.68, 0.31-0.34; lengths of hind tarsomeres I-III: 0.07-0.09, 0.12-0.14, 0.14-0.18. Abdomen pale brown. Male: Unknown.

Dimensions. –  $\eta$ : Body length 2.92-3.08; head width including eyes 0.48-0.51; vertex width 0.21-0.23; rostral length 1.15-1.16; mesal pronotal length 0.24-0.27; basal pronotal width 0.69-0.77; width across hemelytra 1.12-1.20.

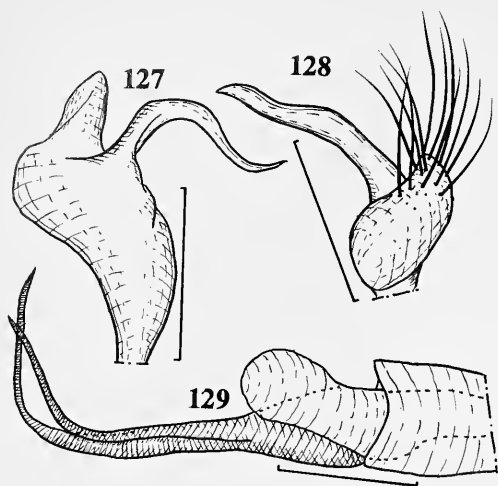
Distribution. – Japan (Okinawa and Amami-Oshima Isls.).

#### *Zanchius takahashii* sp. n. (figs. 112, 127-129)

Type material. – Holotype  $\delta$ , Hirakubo, Ishigaki Is., Ryukyus, Japan, 6.ii.1993, K. Takahashi (HUES). – Paratypes (HUES): Ryukyus: Ishigaki Is.: 1  $\eta$ , Mt. Buzama, 5.xii.1998, K. Takahashi; 1  $\delta$ , 1  $\eta$ , same data as for holotype; 3  $\eta$ , Ban'na Park, 4.iii.1999, T. Yasunaga; 2  $\eta$ , Shiramizu, 7.iii.1999, T. Yasunaga; 1  $\eta$ , Maesato, 7.ii.1998, K. Takahashi; 2  $\eta$ , Itona, 9.v.1993, T. Yasunaga. – Iriomote Is.: 1  $\eta$ , Mombanare, 11.v.1993, T. Yasunaga; 1  $\eta$ , Komi, 13.v.1993, T. Yasunaga.

Diagnosis. – Recognized by the small, suboval body, short antenna, and characteristic dark spots on inner corner of the corium and small cell of the membrane (fig. 112). Similar in general appearance to the Taiwanese *Zonodoropsis pallens* Poppius, 1915, from which *takahashii* is easily distinguished by the reddish annulations on the antennal segment II, dark extreme bases of the antennal segments III and IV, and small dark spots on inner corner of the corium and small cell of the membrane. The final instar nymph of *takahashii* is recognized by the rather slender, pale green body with somewhat brownish, setose abdominal terga.

Description. – Body generally pale green, tiny, oval, slightly elongate in  $\delta$ ; dorsal surface sparsely clothed with simple, pale pubescence. Head vertical, with silky, erect pubescence; eyes small, vertex flat,



Figs. 127-129. Male genitalia of *Zanchius takahashii* – 127, right paramere; 128, left paramere; 129, vesica. Scales: 0.1 mm.

with basal transverse carina laterally continuing to posterior margins of eyes; frons subtriangularly projected, concealing tylus in dorsal view. Antenna yellow, with silky pubescence; segment II with 2 pale red annulations at base and apical 2/3; extreme bases of filiform segments III and IV darkened; lengths of segments I-IV ( $\delta/\eta$ ): 0.25-0.26/0.25-0.27, 0.85-0.86/0.90-0.92, 0.39-0.40/0.44-0.45, 0.36-0.37/0.34-0.40. Rostrum pale brown, slightly exceeding apex of middle coxa. Pronotum short, wide; calli flat; mesoscutum somewhat swollen; scutellum flat, weakly shagreened. Hemelytra pale green, subhyaline, flat and wide; inner margin of corium with a brown spot behind apex of clavus; extreme apex of embolium deep green; apical lateral part of cuneus sometimes with deep green spot; membrane sombre yellowish brown, semitransparent, with a dark spot on smaller cell. Leg yellowish brown; tibial spines pale brown; lengths of hind femur, tibia and tarsus ( $\delta/\eta$ ): 0.76-0.81/0.83-0.88, 1.28-1.30/1.26-1.35, 0.19-0.21/0.18-0.21; lengths of hind tarsomeres I-III ( $\delta/\eta$ ): 0.06-0.07/0.06-0.07, 0.09-0.10/0.08-0.11, 0.11-0.13/0.12-0.13. Abdomen almost unicolorously yellowish brown. Male genitalia (figs. 127-129): Parameres rather symmetrical in form; left paramere with conspicuously long setae (fig. 128); right paramere with elongate, curved hypophysis (fig. 127); vesica with pointed, bifurcate, apically curved sclerite (fig. 129).

Dimensions. –  $\delta/\eta$ : Body length 2.97-3.06/3.00-3.15; head width including eyes 0.44-0.46/0.45-0.46; vertex width 0.15-0.17/0.19-0.21; rostral length 0.73/0.79-0.81; mesal pronotal length 0.22-

0.24/0.25-0.27; basal pronotal width 0.63-0.69/0.66-0.70; width across hemelytra 0.95-0.97/1.10-1.14.

Distribution. – Japan (Ryukyus: Ishigaki and Iriomote Isls.).

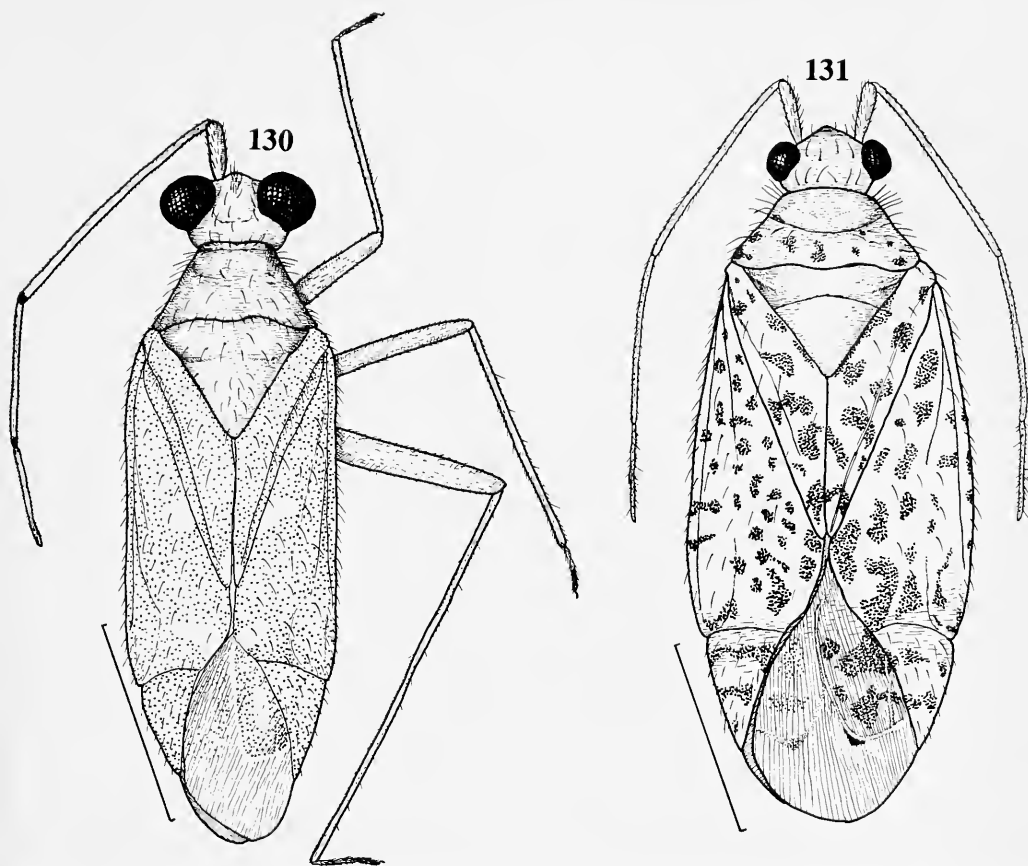
Biology. – This new species was found on *Pueraria* sp. (Leguminosae) and *Pipturus arborescens* (Link) C. B. Rob. (Urticaceae), with which numerous typhlocybinid leafhoppers (e.g., *Anufrievia* sp., *Limassolla* sp.) were associated. The final instar nymphs were found on *Macaranga tanarius* with a typhlocybinid leafhopper, *Davmata* (or *Tautoneura*) sp. Presumably, *Z. takahashii* preys on these leafhoppers.

*Zanchius gigantoculus* sp. n.  
(figs. 130, 132-134)

Type material. – Holotype:  $\delta$ , Mt. Yuwandake, Uken Vil., Amami-Oshima Is., Ryukyus, Japan, 29.v.1993, T. Yasunaga (HUES). – Paratypes (HUES): JAPAN, Ryukyus: 1  $\delta$ , same data as for holotype; 1  $\eta$ , Yona, Kunigami Vil., Okinawa Is., 20-25.v.1993, light trap, Y. Nakatani; 1  $\delta$ , 5  $\eta$ , same data except for 15-18.v.1998; 1  $\delta$ , Okuni-Rindo, Kunigami Vil., Okinawa Is., 14.v.1998, light trap, Y. Nakatani.

Diagnosis. – Recognized by the generally pale green dorsum with white markings on the hemelytra, large eyes, smooth base of the vertex, ventral apical sanguineous spot of the antennal segment I, sanguineous extreme apices of the antennal segments II and III, and partly punctate corium, cuneus and membrane cells. This new species is distinct in having a parallel-sided body, conspicuously enlarged eyes in the male, reduced basal transverse carina of the vertex and pronotal collar, punctate hemelytra and membrane cell (fig. 130), strong projection on the male genital segment (fig. 129), basally developed left paramere (fig. 133), tiny right paramere, and 4 sclerites on the vesica (fig. 134, sclerites 1-4). Similar male genital structure is exhibited in *Z. vittelinus* described from China by Zou (1989), and it is considered to be a sister species of *gigantoculus*.

Description. – Body generally pale or yellowish green, elongate oval, parallel-sided; dorsal surface shiny, sparsely pubescent. Head vertical; eyes prominent, conspicuously projected in  $\delta$ , distinctly removed from anterior margin of pronotum; vertex lacking basal transverse carina, with a pair of rounded depressions; frons weakly projected; tylus rather flat, invisible in dorsal view. Antennae yellow; segment I with a ventral apical sanguineous spot, shorter than mesal length of head; extreme apices of segments II and III narrowly sanguineous; lengths of segments I-IV ( $\delta/\eta$ ): 0.33-0.38/0.33-0.34, 1.45-1.55/1.29-1.37, 1.05-1.11/1.00-1.04, 0.55-0.71/0.67-0.72. Rostrum reaching apex of hind coxa. Pronotum weakly sha-



Figs. 130, 131. Dorsal habitus of *Zanchius gigantoculus*, male (127) and *Malacocorisella endoi*, female (128). Scales: 1.0 mm.

greened posteriorly, narrow, with sparse, silky, suberect pubescence; calli shiny; collar almost completely reduced; mesoscutum and scutellum bearing silky, suberect setae; mesoscutum wide, about as wide as pronotum; scutellum large. Hemelytra subhyaline, pale green, sparsely provided with silky, suberect pubescence along veins; corium with two white markings at middle and apex, finely punctate along radius; clavus white between claval vein and suture; lateral margin of cuneus and membrane cells punctate; membrane pale brown, semitransparent, with pale green cells. Legs yellow; tibial spine pale brown; tarsomeres III dark brown; lengths of hind femur, tibia and tarsus ( $\delta/\eta$ ): 1.39-1.50/1.22-1.44, 2.28-2.40/1.99-2.21, 0.38-0.39/0.31-0.41; lengths of hind tarsomeres I-III ( $\delta/\eta$ ): 0.09-0.13/0.10-0.12, 0.18-0.20/0.13-0.16, 0.17-0.19/0.13-0.16. Male genitalia (figs. 128-130): Genital segment with a prominent, right lateral projection (fig. 129); right

paramere oval, tiny; left paramere developed basally, with slender and apically hooked hypophysis (fig. 130); vesica with 4 sclerotized appendages (fig. 134, 1-4) — apical broad pointed sclerite (1), elongate broad sclerite (2) and long thin sclerite (3), and mesial spinulate sclerite (4).

Dimensions. —  $\delta/\eta$ : Body length 3.72-3.84/3.43-4.04; head width including eyes 0.72-0.77/0.62-0.68; vertex width 0.24-0.25/0.25-0.29; rostral length 1.24-1.35/1.20; mesal pronotal length 0.45-0.48/0.40-0.46; basal pronotal width 0.90-0.93/0.81-0.92; width across hemelytra 1.20-1.31/1.10-1.30.

Distribution. — Japan (Ryukyus: Amami-Oshima and Okinawa Is.).

Biology. — This new species was collected on flowers of an undetermined evergreen broadleaved tree, and by light traps. No other information is available on the biology.

*Malacocorisella* gen. n.

Type species. — *Malacocorisella endoi* Yasunaga sp. n.

Diagnosis. — Recognized by the small size, oval body, small eye removed from the pronotum, smooth vertex, short antenna, widely exposed mesoscutum (figs. 113, 131), and peculiar male genital structure as described below (figs. 135-138).

Description. — Body oval, small; dorsal surface sparsely clothed with brown, suberect setae. Head vertical, bearing pale, erect pubescence; eyes small, distinctly removed from anterior margin of pronotum; vertex smooth, wide, lacking basal transverse carina; frons roundly projected. Antennae short. Rostrum slightly exceeding apex of middle coxa. Pronotum short, bearing brown, suberect setae, with a transverse suture along posterior margin of calli; collar reduced; mesoscutum strongly exposed, about as wide as pronotum, obliquely carinate laterally, with sparse, brown setae; scutellum arched, pruinose, bearing sparse, brown setae. Hemelytra somewhat pruinose, uniformly clothed with pale brown, suberect setae. Male genitalia (figs. 135-138): Genital segment sharply excavated, without any noticeable processes (fig. 135); left paramere broad, with straight hypophysis (fig. 136); right paramere twisted apically, terminated in sharp apex (fig. 137); vesica with two long sclerites that are connected with phallobase by very flexible membranous tubes (fig. 138).

Etymology. — From the Palearctic genus *Malacocoris* Fieber, which is considered to be a close relative of this new genus; gender feminine.

Discussion. — The present new genus resembles *Malacocoris* Fieber, 1858, known by 3 species from Europe, Burma and India, respectively, but is distinct in having a small and oval body, smooth vertex, short antennae and legs, and very unique male genitalia.

*Malacocorisella* is known by a single, temperate species associated with walnut.

*Malacocorisella endoi* sp. n.

(figs. 113-114, 131, 135-138)

Type material. — Holotype ♂, Aoyama, Tobetsu T., Ishikari, Hokkaido, Japan, ex *Juglans ailantifolia*, 6-11.viii.1997, R. Endo (HUES). — Paratypes: 128 specimens (HUES) from the following localities of Japan: Hokkaido: Same as holotype; Hattari, Atsuta Vil., Ishikari. — Honshu: Misato T. & Koya-Hanasaka, Wakayama Pref. — Shikoku: Yusuhara, Kochi Pref.; Yukimigawa & Same'ura, Motoyama T., Kochi Pref.

Diagnosis. — Easily recognized by the oval body, small eyes, strongly exposed mesoscutum, and dense, irregular green spots on the hemelytra and membrane cells (figs. 113, 131). The final instar nymph is recog-

nized by the pale green, elongate oval body similar to that of the adult, green apical annulations of the hind femur, and rows of small, brown spots along posterior margins of the abdorminal terga (fig. 114).

Description. — Body pale green. Head with an obscure stripe behind each eye. Antennae uniformly yellowish brown; segment I bearing brown, suberect setae; lengths of segments I-IV (♂/♀): 0.28-0.29 / 0.28-0.30, 1.08-1.18/1.00-1.04, 0.64-0.72/0.64-0.65, 0.45-0.48 / 0.48-0.51. Pronotum pruinose, with several green spots posteriorly. Hemelytra and membrane cells pale green, somewhat pruinose, densely and irregularly mottled with many green spots; membrane pale brown, semi-transparent, with a dark spot at posterior apex of veins. Legs pale green; hind femur with several green spots; tibial spines pale brown; apices of tarsomeres III brown; lengths of hind femur, tibia and tarsus (♂/♀): 1.10-1.18/1.17-1.20, 1.72-1.80/1.82-1.90, 0.33-0.36/0.33-0.39; lengths of hind tarsomeres I-III (♂/♀): 0.10-0.12/0.09-0.12, 0.14-0.16/0.15-0.17, 0.14-0.17 / 0.14-0.18. Abdomen unicolorously pale green. Male genitalia as mentioned in generic description.

Dimensions. — ♂/♀: Body length 3.33-3.36/3.48-3.60; head width including eyes 0.62-0.63/0.57-0.60; vertex width 0.26-0.27/0.28-0.32; rostral length 1.08-1.11/1.15-1.20; mesal pronotal length 0.38-0.41/0.38-0.39; basal pronotal width 0.91-0.94/0.88-0.92; width across hemelytra 1.44-1.47/1.46-1.52.

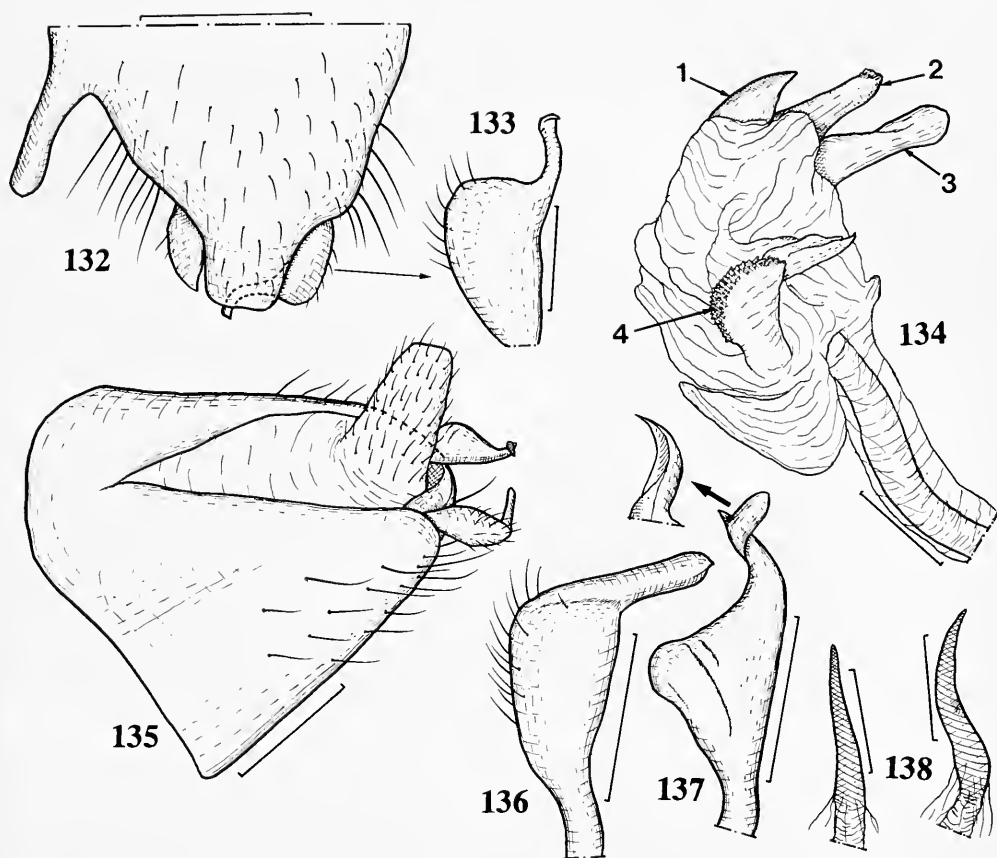
Distribution. — Japan (Hokkaido, Honshu, Shikoku).

Biology. — This new species was confirmed to be associated strictly with a Japanese walnut, *Juglans ailantifolia* Carr. One generation per year is assumed for *M. endoi*, and the newly emerged adults appear in early August.

*Pseudoloxops* Kirkaldy

*Pseudoloxops* Kirkaldy, 1905: 268, type species: *Capsus coccineus* Meyer-Dür, 1843, monotypic (nom. n. for *Loxops* Fieber, 1858: 314, preocc. by *Loxops* Cabanis, 1847, Aves); Schuh 1995: 184.

This genus currently comprises 35 species (9 Afrotropical, 17 Indo-Pacific and 9 Palearctic) that are, without exception, easily recognized by the unique coloration. A single species, *P. coccineus*, was reported from North America, but it is considered to have been accidentally introduced with European ash nursery stock (Wheeler & Henry 1992). In Japan 4 species occur, and are readily distinguished from one another by the superficial appearance alone. Although some external diagnostic characters are unique to *Pseudoloxops* as redescribed by Linnavuori (1994) and Wagner (1973), it is difficult to explain the genus as a monophyletic



Figs. 132-138. Male genitalia of *Zanchius gigantoculus* (132-134) and *Malacocorisella endoi* (135-138). – 132, genital segment in ventral view; 135, the same, in left dorsolateral view; 133, 136, left paramere; 137, right paramere; 134, vesica; 138, vesical sclerites. Scales: 0.2 mm for 132, 135, 0.1 mm for 133-134, 136-138.

group because of the great interspecific variation exhibited in the male genitalia. A much broader survey on characters is required to correctly redefine *Pseudoloxops*.

The majority of *Pseudoloxops* species appear to be associated with broadleaved host plants, whereas predation was observed in a European species, *P. coccineus* Meyer-Dür (Wheeler & Henry 1992).

*Pseudoloxops miyatakei* Miyamoto  
(figs. 139, 145-146)

*Pseudoloxops miyatakei* Miyamoto, 1969: 75; Schuh 1995: 185; Yasunaga 1997: 11.

**Diagnosis.** – Recognized by the comparatively large size, uniformly distributed dark spots on the widely scarlet dorsum, mesally yellowish hemelytra, entirely yellow femur (fig. 139), two characteristic

processes on the genital segment (fig. 145) (in the original description, these processes were referred to as ‘a sharp median projection on hind margin of ventral wall’ and ‘erect spatula-shaped projection’), remarkably widened sensory lobe of the left paramere (fig. 146), and 3-branched apical appendage of the vesica. Length 3.5-4.1; width 1.4-1.6. Detailed descriptions of male and female adults were provided by Miyamoto (1969) and Yasunaga (1997), respectively.

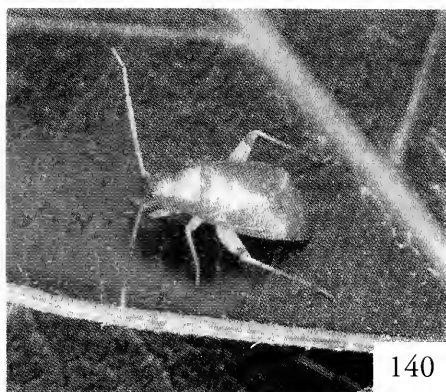
**Distribution.** – Japan (Honshu, Shikoku, Kyushu).

**Biology.** – The only information is that this rare mirid is occasionally attracted to light.

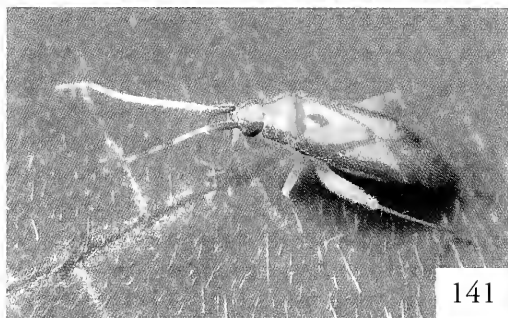
**Material examined.** – 8 specimens (HUES) were examined from the following localities: Honshu: Mt. Haguro, Haguro T., Yamagata Pref.; Mt. Wasamata, Kamikitayama Vil., Nara Pref. – Shikoku: Befe, Monobe Vil., Kochi Pref. – Kyushu: Shimizu, Shonai T., Oita Pref.



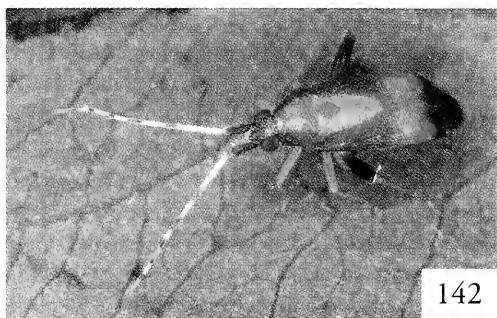
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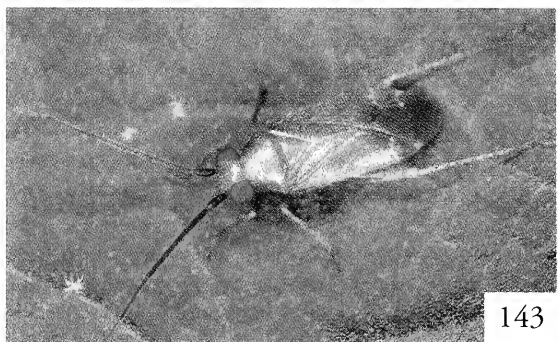
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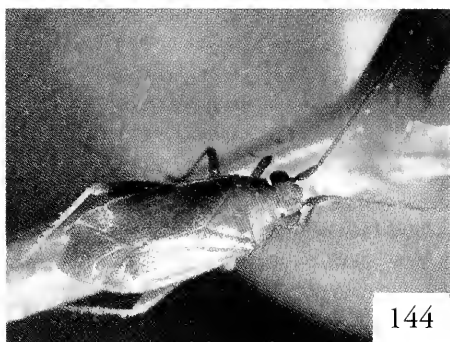
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143



144

Figs. 139-144. Male (142, 143) and female (139-141, 144) adults of *Pseudoloxops miyatakei* (139), *P. miyamotoi* (140), *P. imperatorius* (141), *P. takaii* (142), and *Pseudoloxopidea pinicola* (143-144).

*Pseudoloxops miyamotoi* Yasunaga  
(figs. 140, 147-149)*Pseudoloxops miyamotoi* Yasunaga, 1997: 15.

Diagnosis. — Easily ecognized by the small, oval body, rounded frons, noticeably shortened antennal segment I, well developed hind femur provided with an apical sanguineous spot (fig. 140), a pointed, subapical process of the left paramere (fig. 148), and birdhead-shaped right paramere (fig. 149). Length 2.9-3.2; width 1.2-1.4. A detailed description was provided by Yasunaga (1997). Its close relative appears to be a Chinese *P. guttatus* Zou, judging from the affinity of the parameres, but the latter significantly differs in the coloration and structure, in addition to being associated with the Rosaceae and Rhamnaceae host plants (Zou 1987b).

Distribution. — Japan (Honshu\*, Kyushu).

Biology. — This mirid is associated strictly with the oak, *Quercus acutissima* Carruthers, and has a univoltine life cycle. The newly emerged adults usually appear from late July to early August.

Material examined. — 1 ♂, Mt. Mikusa, Inagawa T., Hyogo Pref., 17.vii.1997, Y. Nakatani (HUES); 3 ♂, 24 ♀, Konoura, Sotome T., Nishisonogi-gun, Nagasaki Pref., Kyushu, on *Quercus acutissima*, 1-4.viii.1996, T. Yasunaga (holotype & paratypes, HUES).

*Pseudoloxops imperatorius* (Distant)  
(fig. 141)*Aretas imperatorius* Distant, 1909: 451.*Pseudoloxops imperatorius* — Carvalho 1958: 128; Schuh 1995: 185.

Diagnosis. — Recognized by the elongate oval body, oblique head, small eyes, widely sanguineous antennal segment I, pale red annulations of the yellow segments II, III and IV, yellow pronotum with sanguineous lateral margins, pale red, mesial, ovoid mark on the scutellum, M-shaped sanguineous mark on the yellow hemelytra, and almost entirely yellow legs (fig. 141).

Redescription. — Female: Body elongate oval, subparallel-sided; dorsal surface yellow with sanguineous marks, shining, densely clothed with brown, suberect setae. Head yellow, sometimes tinged with red in front, with silky setae. Antenna creamy yellow; segment I widely sanguineous, with stiff, suberect setae and silky, erect pubescence; segment II, III and IV each with a few, pale red annulations, bearing silky pubescence; lengths of segments I-IV: 0.37-0.38, 1.21-1.22, 0.46-0.48, 0.41-0.46. Rostrum yellow, reaching apex of middle coxa; apical part of segment IV darkened. Pronotum widely shiny yellow mesally, sanguineous and spotted laterally; mesoscutum creamy yellow; scutellum creamy yellow with a pale

red, ovoid mark mesially; pleura creamy yellow. Hemelytra yellow mesally, with small, obscure spots laterally; base of clavus, basal half and each margin of corium, embolium and cuneus sanguineous; lateral bases of cuneus yellow; membrane pale greyish brown, semitransparent, with apically sanguineous veins. Leg almost unicolorously yellow; apex of hind femur sometimes narrowly red; tibial spines pale brown; lengths of hind femur, tibia and tarsus: 1.23-1.27, 1.58-1.75, 0.28-0.30; lengths of hind tarsomeres I-III: 0.10-0.13, 0.13-0.16, 0.18-0.22. Abdomen yellow; valvulae darkened apically.

Male: Unknown.

Dimensions. — ♀: Body length 3.33-3.69; head width including eyes 0.57-0.59; vertex width 0.30-0.31; rostral length 0.83-0.94; mesal pronotal length 0.31-0.32; basal pronotal width 0.79-0.84; width across hemelytra 1.10-1.23.

Distribution. — Japan (Shikoku, Okinawa Is. and Ishigaki Is.), Sri Lanka; it is considered to be distributed widely over the regions between southern Japan and Sri Lanka.

Material examined. — JAPAN: Shikoku: 2 ♀, Cape Muroto, Kochi Pref., 27.v.1997, light trap, I. Yamashita (HUES). — Ryukyus: 1 ♀, Okunirindo, Kunigami Vil., Okinawa Is., 14.v.1998, light trap, Y. Nakatani (HUES); 1 ♀, Hiji, Kunigami Vil., Okinawa Is., 19.v.1998, light trap, Y. Nakatani (HUES); 1 ♀, Ura, Okinawa Is., 27.vi.1992, M. Hayashi (HUES) — SRI LANKA: 1 ♀, Peradeniya, Ceylon, 4-05, Distant Coll./1911-383 (holotype, BMNH).

*Pseudoloxops takaii* Yasunaga  
(figs. 142, 150-152)*Pseudoloxops takaii* Yasunaga, 1997: 12.

Diagnosis. — Recognized by the slender and small body, mesally yellowish dorsum that lacks dark spots, widely reddish brown apical part of the hind femur (fig. 142), dark, apical spines of the male genital segment (fig. 150), widened left paramere with slender hypophysis (fig. 151), and elongate right paramere (fig. 152). Length 3.0-3.7; width 1.0-1.4. The final instar nymph is easily recognized by the unique general coloration quite similar to that of adult. Detailed descriptions of both adult and final instar nymph were provided by Yasunaga (1997). Closely allied to *imperatorius*, *takaii* is easily distinguished from it by the narrower mesal yellow part on the dorsum and widely reddish apical part of the hind femur.

Distribution. — Japan (Shikoku\*, the Ryukyus: Okinawa, Ishigaki and Iriomote\* Is.).

Biology. — Confirmed breeding host plants of *takaii* are *Quercus* (*Cyclobalanopsis*) sp., *Castanopsis* sp. (Fagaceae) and *Styrax japonica* Sieb. et Zucc. (Styracaceae), from which final instar nymphs were collect-

ed. Collection records suggest the possibility of bi- or multivoltine life cycles for *P. takaii*, since teneral adults were collected in January and May.

Material examined. – 26 specimens including types (HUES) from the following localities of Japan: Shikoku: Kanda, Kochi C., Kochi Pref. – Ryukyus: Okinawa Is.: Yona, Kunigami Vil. (paratypes). – Ishigaki Is.: Mt. Banna (paratype); Ban'na Park; Shiramizu; without detailed locality data (paratypes); Mt. Omoto (paratypes); Omoto-Takeda (holotype & paratypes); Miyara. – Iriomote Is.: Sonai-Shirahama.

# *Pseudoloxopidea* gen. n.

Type species. – *Pseudoloxopidea pinicola* Yasunaga, sp. n.

Diagnosis. – Recognized by the unicolorously pale brown general coloration, small size, regularly distributed dark spots on the dorsum, short, vertical head, very short antennal segment I (figs. 143, 144), apical spine-like setae of the male genital segment (fig. 154), slender parameres, and 3 apical spiculi of the vesica (fig. 155).

Description. – Body almost unicolorously pale brown, small, elongate oval, subparallel-sided; dorsal surface moderately shining, uniformly provided with dark, small spots each bearing a simple, suberect seta. Head short, vertical, flattened in front, with dark, erect setae. Antennal segment I very short, shorter than eye length, bearing several, dark, erect spines. Rostrum reaching apex of middle coxa. Pronotum rather narrow, with narrow collar; calli indistinct; mesoscutum wide; scutellum weakly arched. Hind tibia with large dark spots at bases of brown, prominent spines. Male genitalia (figs. 153-155): Genital segment with distinct, pale, spine-like setae apically (fig. 154); parameres slender; right paramere with apical teeth (fig. 153); vesica membranous, with 3 distinct, horn-like spiculi (fig. 155).

Etymology. – From the generic name *Pseudoloxops* Kirkaldy, to which this new genus is allied; gender feminine.

Discussion. – This new genus is allied to *Pseudoloxops*, from which it can be distinguished by the characters as diagnosed above. Especially, the structures of head and male genitalia of *Pseudoloxopidea* are distinctly different from those exhibited in *Pseudoloxops*.

*Pseudoloxopidea* is represented by a subtropical, pine-inhabiting species.

*Pseudoloxopidea pinicola* sp. n.  
(figs. 143-144, 153-155)

Type material. – Holotype ♂, Mt. Bansei (Maese),

Ishigaki Is., Ryukyus, Japan, 20.xi.1997, T. Yasunaga (HUES). – Paratypes: 45 specimens (HUES) from the following localities of the Ryukyus, Japan: Okinawa Is.: Sate, Yona & Mt. Terukubi, Kunigami Vil. – Ishigaki Is.: Omoto; Mt. Omoto; Maesato Reservoir; same as holotype. – Iriomote Is.: Komi, Funaura, Shirahama & Mt. Uehara.

Diagnosis. – Recognized by the characters as diagnosed in the generic diagnosis. This small species may be confused with certain species of the Phylinae, from which *P. pinicola* is distinguished by the fleshy, apically convergent parempodia between the claws.

Description. – Body almost uniformly pale brown, partly slightly reddish. Head pale brown; vertex 0.36-0.40 (♂)/0.48-0.51 (♀) times as wide as head. Antenna pale brown; segment I brown or reddish brown; lengths of segments I-IV (♂/♀): 0.26-0.27/0.28-0.32, 1.12-1.18/1.10-1.24, 0.45-0.49/0.47-0.57, 0.25-0.32/0.33-0.38. Rostrum pale brown; apical part of segment IV darkened. Spots on mesal part of pronotum, mesoscutum and scutellum sometimes reduced. Basal margin of cuneus pale; membrane pale greyish brown. Leg pale brown; tibia with dark spots; lengths of hind femur, tibia and tarsus (♂/♀): 0.98-1.02/1.06-1.11, 1.31-1.38/1.40-1.52, 0.30-0.32/0.30-0.32; lengths of hind tarsomeres I-III (♂/♀): 0.11-0.13/0.10-0.13, 0.15-0.18/0.16-0.18, 0.17-0.19/0.18-0.19. Abdomen pale brown, somewhat tinged with red laterad. Male genitalia as mentioned in generic description.

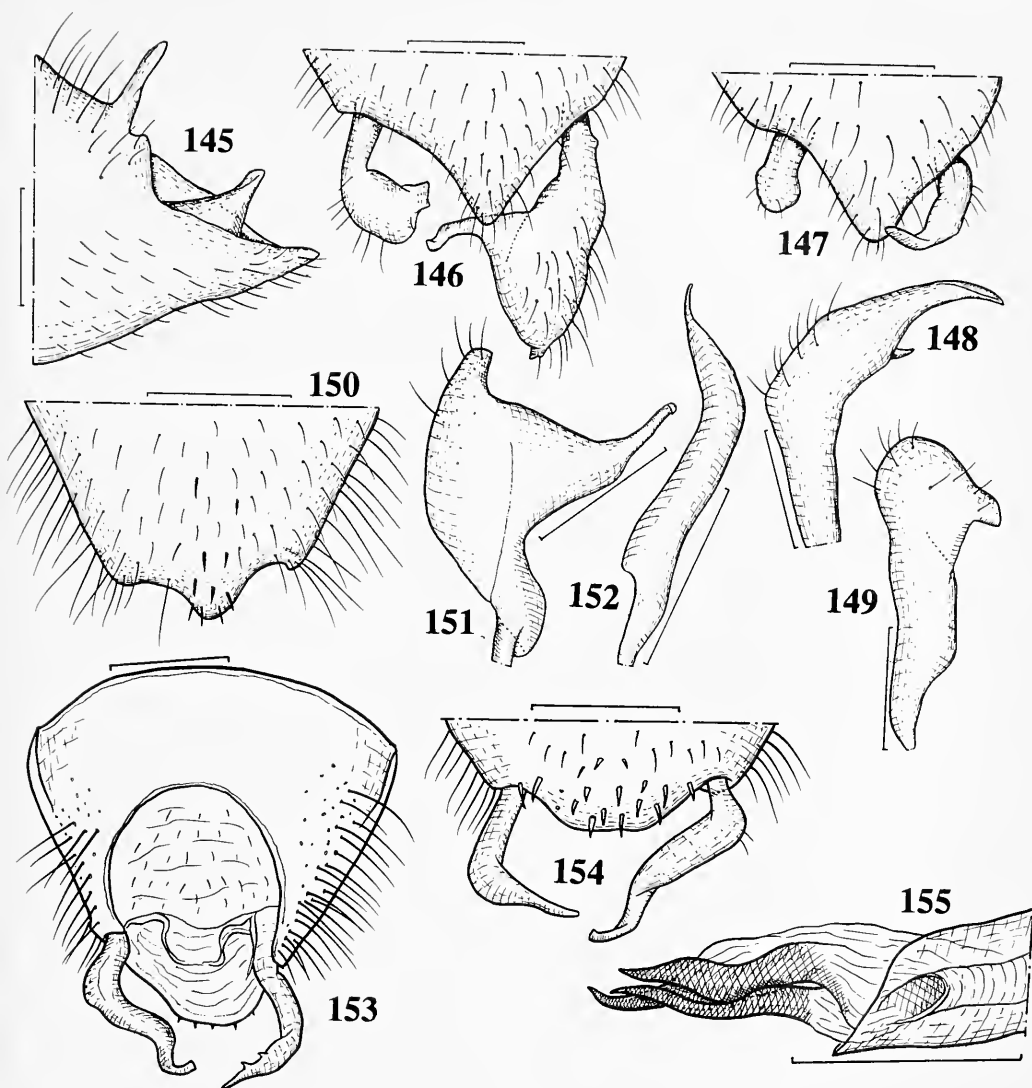
Dimensions. – ♂/♀: Body length 3.03-3.24/3.09-3.45; head width including eyes 0.63-0.67/0.62-0.68; vertex width 0.22-0.27/0.31-0.33; rostral length 0.76-0.80/0.79-0.81; mesal pronotal length 0.38-0.43/0.37-0.40; basal pronotal width 0.77-0.80/0.79-0.89; width across hemelytra 0.95-1.04/0.95-1.16.

Distribution. – Japan (Ryukyus: Okinawa, Ishigaki and Iriomote Is.).

Biology. – This new species was collected from a subtropical pine, *Pinus luchuensis* Mayr (Pinaceae) that is regarded as the breeding host, and is frequently attracted to light. The collection records suggest that this mirid has two or more generations per year.

## KEY TO JAPANESE GENERA, SUBGENERA AND SPECIES OF ORTHOTYLINI

1. Pronotum strongly constricted at calli, forming distinct anterior and posterior lobes ..... 2
- Pronotum almost uniform, not constricted at calli ..... 6
2. Eyes not touching anterior margin of pronotum; vertex smooth; antennal segment I much longer than head width ..... 3 (*Cyllocoris*)
- Eyes almost contiguous to anterior margin of



Figs. 145-155. Male genitalia of *Pseudoloxops miyatakei* (145-146), *P. miyamotoi* (147-149), *P. takaii* (150-152) and *Pseudoloxopidea pinicola* (153-155). – 145, genital segment in left lateral view; 150, the same, in ventral view; 153, the same, with parameres in dorsal view; 145, 147, 154, the same, with parameres in ventral view; 148, 151, left paramere; 149, 152, right paramere; 155, vesica. Scales: 0.2 mm for 145-147, 150-155, 0.1 mm for 148-149.

- pronotum; vertex with a transverse carina basally; antennal segment I shorter than head width ..... 4 (*Dryophilacoris*)
3. Body larger, longer than 7 mm and wider than 1.9 mm; antennal segment I tinged with red; pronotum polished, very shiny with continuously pale posterior margin; oak inhabitant ..... *Cyllecoris vicarius*
- Body shorter and slenderer, shorter than 6.6 mm and narrower than 1.5 mm; antennal segment I dark brown; pronotum widely shagreened or pruinose, with dark and mesally pale posterior margin; elm inhabitant ..... *C. nakanishii*
4. Pronotum behind calli pruinose ..... *Dryophilacoris miyamotoi*
- Pronotum behind calli shiny, polished, not pruinose ..... 5
5. Pronotum distinctly pubescent ..... *D. saigusai*
- Pronotum almost glabrous ..... *D. lucidus*
6. Pronotum and hemelytra more or less with scattered, dark, small spots (figs. 139-144) ..... 7
- Pronotum and hemelytra lacking such spots ..... 11
7. Hemelytra unicolorously pale brown ..... *Pseudoloxopidea pinicola*
- Hemelytra bicolorous, sanguineous or reddish brown laterally and yellow or pale brown mesally ..... 8 (*Pseudoloxops*)
8. Pronotum and scutellum uniformly furnished with dark, small spots (fig. 139) ..... *Pseudoloxops miyatakei*
- At least mesal parts of pronotum and scutellum lacking dark, small spots ..... 9
9. Antennal segments II and III unicolorously pale brown; pronotum and hemelytra pale reddish brown laterally; scutellum entirely pale brown (fig. 140) ..... *P. miyamotoi*
- Antennal segment II and III with 3-4 reddish rings; lateral parts of pronotum and hemelytra sanguineous or deep red; scutellum yellow, with oval, reddish mark mesially (figs. 141, 142) ..... 10
10. Hind femur entirely yellow, or sometimes narrowly pale red at apex (fig. 141) ..... *P. imperatorius*
- More than apical half of hind femur deep red (fig. 142) ..... *P. takaii*
11. Eyes situated anteriorly, distinctly removed from pronotum as in figs. 130, 131 ..... 12
- Eyes contiguous or subcontiguous to pronotum ..... 19
12. Antennal segment I very long, much longer than pronotal width (fig. 94) ..... *Mecommopsis cruciata*
- Antennal segment I apparently shorter than pronotal width ..... 13
13. Antenna entirely pale, without any annulation or stripe ..... *Malacocorisella endoi*
- Antenna somewhere with red or dark spot, annulation or stripe ..... 14 (*Zanchius*)
14. Body suboval, less than 3 times as long as maximum width; inner corner of corium and small membrane cell each with a dark brown spot (fig. 112) ..... *Zanchius takahashii*
- Body elongate oval, more than 3 times as long as maximum width; corium and membrane without dark spots ..... 15
15. Pronotum with both dark and pale setae ..... *Z. nakatanii*
- Pronotum only with simple, pale setae ..... 16
16. Head with a scarlet lateral stripe or spot behind each eye ..... 17
- Head without any marking behind eye ..... 18
17. Body larger, more than 4.5 mm in length; tylus projected ..... *Z. tarasovi*
- Body smaller, less than 4 mm; tylus less projected ..... *Z. quercicola*
18. Apical part of antennal segment I with a sanguineous, ventral spot; extreme apex of segment II reddish ..... *Z. gigantoculus*
- Antennal segment I with a black lateral stripe; segment II with 4 black annulations ..... *Z. ryukyuensis*
19. Hemelytra with both simple setae and silvery pubescence ..... 20
- Hemelytra with simple, pale or brown setae ..... 23
20. Antennal segment I short, less than 0.3 mm in length ..... 21 (*Orthotylus (Melanotrichus)*)
- Antennal segment I long, more than 0.4 mm ..... 22 (*Blepharidopterus*)
21. Body smaller, less than 3.2 mm in length; silvery pubescence on hemelytra uniformly distributed ..... *Orthotylus (Melanotrichus) parvulus*
- Body larger, more than 3.5 mm; hemelytra with patches of silvery pubescence (fig. 43) ..... *O. (M.) flavosparsus*
22. Antennal segments I and II pale brown; pronotum entirely pale (fig. 44) ..... *Blepharidopterus ulmicola*
- Antennal segment I and II, and posterior margin of pronotum dark brown ..... *B. striatus*
23. Pronotum entirely pale green (or fading to yellow or pale brown in old specimens) ..... 24
- Pronotum entirely or partly blackish, brownish or reddish ..... 27
24. Extreme base of hind tibia with a dark knee spot (fig. 5) ..... *Orthotylus (O.) japonicus*
- Hind tibia lacking knee spot ..... 25
25. Anterior margin of scutellum and membrane veins infusate ..... *O. (O.) kurlensis*
- Scutellum and membrane veins pale (figs. 3, 39) ..... 26
26. Rostrum short, not exceeding apex of middle coxa ..... *O. (O.) interpositus*
- Rostrum long, exceeding apex of hind coxa ..... *O. (Kiiorthotylus) gotobi*

27. Pronotum, scutellum and hemelytra almost unicolorously reddish brown or dark brown (fig. 41) ..... *O. (Yamatorthotylus) xanthopoda*  
 – Pronotum, scutellum and/or hemelytra bicolorous ..... 28
28. Hemelytra unicolorously pale green (fig. 97) ..... *Cyrtorhinus lividipennis*  
 – Corium and clavus more or less infusate ..... 29
29. Pronotum and scutellum entirely fuscous ..... 30  
 – Pronotum and scutellum always with pale parts ..... 31
30. Body elongate in ♂, more than 5 mm in length; female brachypterous; apex of cuneus infusate ..... *Mecomma japonica*  
 – Body small, less than 4 mm, always macropterous; cuneus entirely pale green (fig. 96) ..... *Cyrtorhinus caricis*
31. Scutellum pale, with mesal dark spot; clavus whitish green, narrowly infusate along inner margin ..... *Orthotylus (Pseudorthotylus) bilineatus*  
 – Scutellum entirely dark, sometimes pale mesally; clavus widely or entirely infusate (fig. 1) ..... 32
32. Body larger, more than 5.2 mm in length; pronotum more than 1.4 mm in width ..... *O. (O.) pallens*  
 – Body smaller, less than 4.8 mm; pronotum less than 1.3 mm ..... *O. (O.) fuscipennis*

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## BOOK REVIEW

Arne Fjellberg, 1998. The Collembola of Fennoscandia and Denmark part I: Poduromorpha. – Fauna Entomologica Scandinavica, 35: 1-184, figs 1-652. E.J. Brill, Leiden, etc. Hardback. [ISBN 90-04-11241-3]. Price NLG 145 (us\$ 85.50).

In the attractive entomological series Fauna Entomologica Scandinavica the new volume 35 deals with the 161 species of the Collembola in the section Poduromorpha which have been recorded from Iceland, the Faeroe Islands, Norway (including the Arctic islands), Sweden, Denmark, and Finland, with the adjacent provinces of Karelian Russia. This volume is the result of 30 years study of the Nordic Collembola fauna by the author and gives identification keys for all the Nordic families of Collembola and all the Nordic species of the section Poduromorpha.

In the introductory chapter two paragraphs are of special importance, i.e. morphology and chaetotaxy. In the paragraph morphology new diagnostic characters are introduced, based in particular on the morphology of the labium. Informative pictures of the morphology of the mouth region clearly show the important internal and external structures, proven to be a source of valuable information in the classification of Collembola. Furthermore, in a separate section, attention is paid to changes in morphology of often important diagnostic characters during the life-span of certain species due to environmental and intrinsic genetic factors. This phenomenon makes the identification of certain species difficult but, when known, the different types of morphs are often illustrated. The paragraph chaetotaxy is devoted to the types of setae that can be distinguished on various part of the body and the notation of setal patterns (of prime importance in current systematics). The introductory chapter gives a good introduction to the many illustrations dealing with the chaetotaxy of individual species throughout the book.

The key to the families and the keys to the species of the families Poduridae (1 sp.), Hypogastruridae (49 spp.), Brachystomellidae (1 sp.), Neanuridae (36 spp.), Odontellidae (4 spp.) and Onychiuridae (70 spp.) are to the point but useful and adequate. A lot of

attention is devoted to a thorough description of each species which is often accompanied with informative line-drawings of dens and mucro, maxilla, mandible and/or labial papillae, postantennal organ, and the setal positions on the head, tibiotarsus, thorax and abdomen. This makes a true check of an identification possible. The position of the species in respect to closely related species is briefly discussed. Short statements on the distribution and ecology of the species complete the descriptions. In this volume of the series one new genus, *Megaphorura*, and three collembolan species new for science, *Friesia danica*, *Micranurida balta* and *Doutnacia mols*, are described while some newly established synonyms are given.

At the end of the book a survey of the knowledge of the distribution of Collembola is presented in the form of a catalogue. For each species the presence in a certain province of the Nordic countries is indicated with symbols. As stated by the author, Norway is clearly over-represented (the home of the author) and many species remain to be recorded especially from Finland, Sweden and Iceland. In combination with the more than 300 literature references, most of them dealing with the distribution of the species in the Nordic countries, a wealth of information is brought together which is of special interest for people dealing with the regional faunistics of groups of soil fauna.

The author and the publisher may be credited for having produced a handy, useful book on an interesting group of soil fauna. The fact that the keys deal with Nordic species of the Collembola may limit its use. However, the good figures which accompany the keys, the newly described species, and the newly established synonyms do ensure this book may nevertheless be used as a reference for scientists working in the temperate region of Europe who investigate Collembola on a wider geographic scale. We eagerly look forward to the second part of this work dealing with the remainder of the Nordic Collembola which will be published in this series in due time!

[M. P. Berg]

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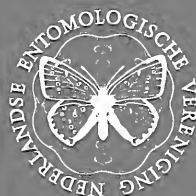
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entomology since 1858



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# A NEW SPECIES OF *TETRARIPIS* FROM THAILAND, WITH A CRITICAL ASSESSMENT OF THE GENERIC CLASSIFICATION OF THE SUBFAMILY RHAGOVELIINAE (HEMIPTERA, GERROMORPHA, VELIIDAE)

Andersen, N.M., 2000. A new species of *Tetraripis* from Thailand, with a critical assessment of the generic classification of the subfamily Rhagoveliinae (Hemiptera, Gerromorpha, Veliidae). – Tijdschrift voor Entomologie 142 [1999]: 185-194, figs. 1-7. [ISSN 0040-7496]. Published 11 April 2000.

*Tetraripis zetteli* sp.n. is described from southwestern Thailand. Additional records and descriptive notes are given for *T. ravana* (Kirkaldy), *T. asymmetricus* J. Polhemus & Karunaratne, and *Chenevelia stridulans* Zetteli. A critical assessment of the generic classification of the subfamily Rhagoveliinae is presented. On basis of shared, unique pretarsal modifications, it is concluded that the Oriental genera *Chenevelia* Zetteli and *Tetraripis* Lundblad, together with the species-rich, world-wide distributed genus *Rhagovelia* Mayr, belong in the monophyletic subfamily Rhagoveliinae.

Correspondence: Nils Møller Andersen, Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen, Denmark.

Key words. – Veliidae; Rhagoveliinae; *Tetraripis*; new species; identification key; generic classification

The water strider family Veliidae (Hemiptera, Gerromorpha) is one of the most diverse groups of semi-aquatic bugs, both with respect to number of species (currently more than 750 described species) and adaptations (Andersen 1982). Many veliids are uniquely adapted to locomotion on water surfaces. Structural adaptations include pretarsal structures which increase the friction between surface film and legs, thus improving the skating ability of the bugs. Several groups of the Veliidae have independently developed 'swimming fans' (Andersen 1982: fig. 531). The most elaborate of these are found in species of the genus *Rhagovelia* Mayr, 1865, which are successfully inhabitants of flowing freshwater throughout the tropical regions of the world.

The genus *Tetraripis* was described by Lundblad (1936) to hold the species *T. ravana* (Kirkaldy, 1901) from Sri Lanka and *Tetraripis doveri* Lundblad, 1936, from Peninsular Malaysia. Lundblad (1936) affiliated and compared his new genus with the genus *Rhagovelia*. This classification was formalized by China & Usinger (1949), who placed both genera in the subfamily Rhagoveliinae, and accepted by subsequent authors (J. Polhemus 1979, Andersen 1982). Lund-

blad (1936) described and illustrated the tarsal morphology of *Tetraripis*, emphasizing that its deeply cleft midtarsus resembles that of *Rhagovelia*. The likewise unique swimming fan of both genera differs in being composed of dichotomously branching hairs in *Tetraripis* whereas the hairs are plumose in *Rhagovelia* (see Lundblad 1936: fig. 32, Andersen 1982: figs 290-291). Unlike the latter genus, *Tetraripis* has similar but smaller swimming fans on its hind tarsi (Lundblad 1936: fig. 31, Andersen 1982: fig. 293). These features are shared with the related genus *Chenevelia* erected by Zetteli (1996) for the species *C. stridulans* Zetteli from North Thailand which is characterized by having stridulatory devices.

Since Lundblad's monograph of the rhagoveliines of the Old World (1936), an additional five species have been added to the genus *Tetraripis* (J. Polhemus 1979, Zetteli 1995, J. Polhemus & D. Polhemus 1998). In the present paper a key to the species of *Tetraripis* is presented and a new species, *T. zetteli* sp. n., is described from southwestern Thailand. Finally, the phylogenetic relationships and generic classification of the Rhagoveliinae is discussed and critically assessed.

## MATERIAL AND METHODS

Throughout the text the apterous (wingless) and macropterous (winged) adults forms are abbreviated apt. and macr., respectively. All measurements in the descriptions are in millimeters. The type material of the new species is deposited in the Zoological Museum, University of Copenhagen (ZMUC) and in the Natural History Museum, Vienna (NHMW). Other material examined belongs to the J. T. Polhemus Collection, Englewood, Colorado (JTPC) and the Zoological Museum, University of Lund, Sweden (ZMUL).

## ACKNOWLEDGEMENTS

Thanks to Peter Nielsen, Nuuk, Greenland, my former student and good friend, for providing the material of the new species. I also thank John T. Polhemus, Englewood, Colorado, U.S.A., Per Brinck, and Lennart Cederholm, Lund, Sweden, for loan of material, and Herbert Zettel, Vienna, Austria, for useful comments on an earlier version of the manuscript. This work is part of a project supported by grants from the Danish Natural Science Research Council (Grant. No. 9801904).

## TAXONOMY

Key to the genera of *Rhagoveliinae*

1. Last segment of both middle and hind tarsi cleft, each provided with a swimming fan inserted at base of the cleft; swimming fan composed of dichotomously branched hairs. Fore tibia of both male and female with grasping comb. .... 2
- Only last segment of middle tarsi cleft and provided with a swimming fan inserted at base of the cleft; swimming fan composed of plumose hairs. Only fore tibia of male with grasping comb. ....  
.....*Rhagovelia*
2. Both male and female with stridulatory devices composed of a 'scraper' on connexival margin of abdominal sterna 2 and 3, and a 'file' on base of hind femur. Anterior margin of pronotum laterally with a narrow and deep incision ..*Chenevelia*
- Without stridulatory devices. Anterior margin of pronotum not deeply incised laterally ..*Tetraripis*

China & Usinger (1949) and Andersen (1982) also recognized the genus *Trochopus* Carpenter, 1898, characterized by having two-segmented tarsi (basal segment of fore and hind tarsi very short), by always being apterous, and by being marine instead of limnic. The five described species are found in the Caribbean and along the Pacific coast of Central and South America (Drake & van Doesburg 1966; Polhemus & del Rosario Manzano 1992). Bacon (1956) and D. Polhemus (1997) include *Trochopus* in the genus *Rhagovelia*.

Genus *Tetraripis* Lundblad

*Tetraripis* Lundblad, 1936: 53. Type-species by original designation: *Rhagovelia ravana* Kirkaldy, 1901.

*Tetraripis* Lundblad; China & Usinger 1949: 351 (classif., key to subfamilies and genera of Veliidae); Andersen 1982: 132-183, figs. 293, 531, 362 (morph., classif., distr.), 412 (syn.), 420 (key to genera); Zettel 1995: 25-30 (taxon., phylog.); Thirumalai & Dam 1996: 69 (key to species); D. Polhemus 1997: 32 (classif.); Hecher 1998: 4, fig. 10 (key, illustr.); J. Polhemus & D. Polhemus 1998: 120-128 (clasif., key).

Distribution. – South India, Sri Lanka, Burma, Thailand, Malaysia (Perak, Kelantan, Sarawak), Indonesia (Java).

## Diagnosis

Last segment of middle tarsus deeply cleft, provided with a swimming fan inserted at base of the cleft; fan composed of a basal stem with dichotomously

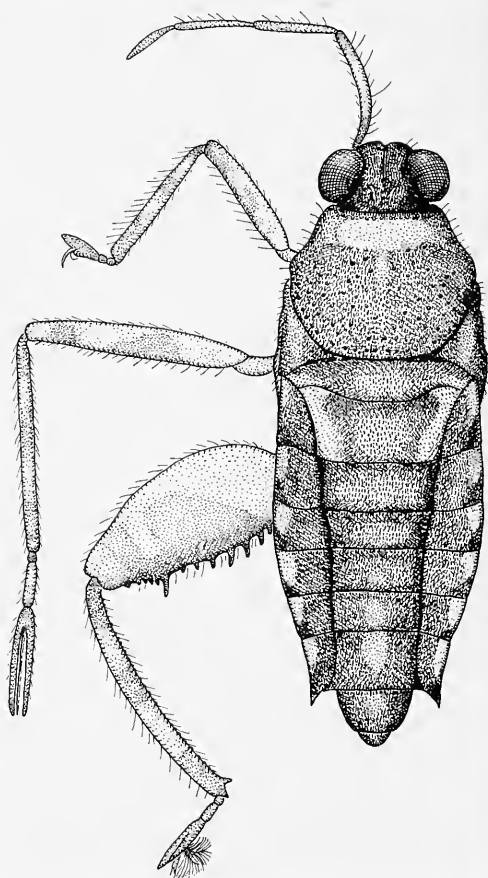


Fig. 1. *Tetraripis zetteli* sp.n., dorsal habitus of apterous male holotype, length 4.15 mm; antenna and legs of right side omitted.

branching hairs arising from both sides. Last segment of hind tarsus with shallow cleft on posterior side, with swimming fan inserted at base of cleft; fan similar to but smaller than that of middle tarsus. Claws of both middle and hind tarsi asymmetrically developed, blade-like. Pronotum of apterous form much longer than head, covering all of mesonotum. Metanotum reduced to a triangular plate laterally on body, behind mesonotum. Fore tibia of both male and female with grasping comb. Fore wings of macropterous form with three white spots; venation forming four closed cells, the two most apical cells extend onto the distal fourth of the wing.

J. Polhemus & D. Polhemus (1998: 128) gave a key to the species of *Tetraripis*. The new species described below runs to couplet 6. The key may be modified as follows to accommodate the new species:

6. Upper margin of female connexival segment 4 with ca. 20 long black hairs arising from posterior half, directed posteromedially. Hind femur of male set with 15-18 teeth, of female with 13-14 teeth ..... 7
- Upper margin of female connexival segment 4 with only a few long hairs. Hind femur of male set with about 25 teeth, of female with about 22 teeth. Java .....  
..... *T. drescheri* J. Polhemus & D. Polhemus
7. Armature of male hind femur composed by 10-12 small teeth and 2-3 distinctly larger teeth. Hind trochanter of male with about 4 small denticles (fig. 3); hind trochanter of female without denticles (Fig. 6). Thailand (SW)..... *zetteli* sp. n.

- Armature of male hind femur composed by 12-14 small teeth and 1-2 distinctly larger teeth. Hind trochanter of male with one large (sometimes double) spine and several small denticles; hind trochanter of female with one small, but distinct spine. Burma .....  
..... *T. chinthe* J. Polhemus & D. Polhemus

### *Tetraripis zetteli* sp.n.

(figs. 1-7)

Type locality. – Thailand, Hua Hin, Prachuab Khiri Khan Province.

Type material. – Holotype ♂, apt., THAILAND (SW), [Prachuab Khiri Khan Prov.], Hua Hin, 6-7.ix.1981, leg. Peter Nielsen (ZMUC). – Paratypes: 5♂ 6♀ apt., 3♂ 6♀ macr., same locality data as holotype (ZMUC, NHMW).

Etymology. – The species is named for Dr. Herbert Zettel, Vienna, in recognition of his excellent work on the systematics and faunistics of aquatic and semi-aquatic Hemiptera of the Oriental region.

### Description

Dimensions. – Body length 3.8-4.15 (apt. ♂), 3.8-4.2 (macr. ♂), 3.95-4.4 (apt. ♀), width (across thorax) 1.3-1.45 (apt. ♂), 1.5-1.65 (macr. ♂), 1.3-1.5 (apt. ♀).

Colour (fig. 1). – Brownish, and yellowish, head, thorax, and sides of abdomen, dark reddish brown, abdominal venter chiefly pale brownish. Pronotal lobe with numerous dark, shiny punctures. Antennae brownish yellow, base of segment 1 and distal parts of all segment, brownish. Trochanters yellowish; femora

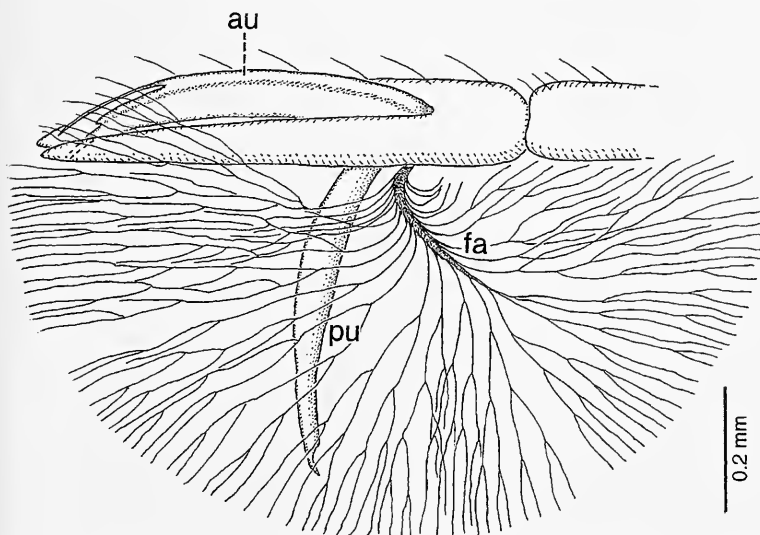
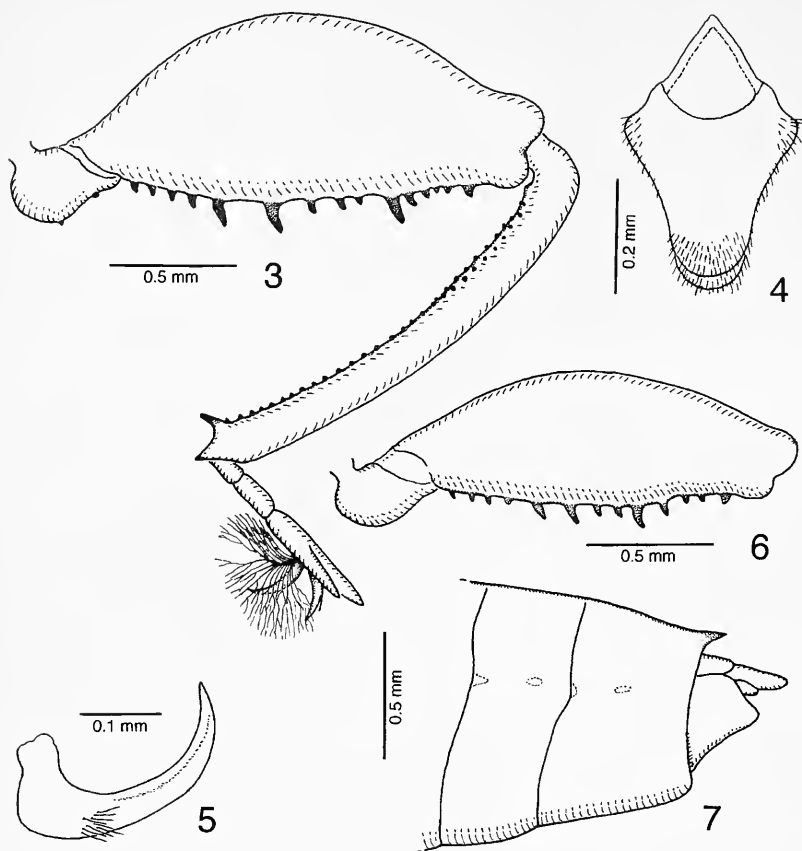


Fig. 2. *Tetraripis zetteli* sp.n., deeply cleft, last segment of left middle tarsus (lateral view) showing asymmetrical claws and pretarsal swimming fan. Abbreviations: fa, swimming fan; ua, anterior claw (ungues); up, posterior claw.



Figs. 3-7. *Tetrarhipis zetteli* sp.n. — 3, right hind leg of apterous male (pilosity omitted); 4, proctiger of male (dorsal view); 5, left paramere of male (lateral view); 6, right hind femur of apterous female (pilosity omitted); 7, abdominal end of apterous female (lateral view).

yellowish with brownish bands in middle and distal parts; tibiae yellowish with basal, middle, and distal parts brownish; tarsi brownish, segment 2 of middle tarsus yellowish. Abdominal tergum chiefly dark brownish, terga 5-7 (♂), or 5-8 (♀) shiny; each connexival segment with a pale, triangular spot. Fore wing of macropterous form brownish, each with three whitish spots: one elongate spot at along anterior margin of basal part, one elongate spot in middle, and an irregular, quadrate spot in distal part.

**Pilosity.** (Head, prothorax, and most of abdomen with dense pilosity of long, semierect hairs; abdominal venter also with pilosity of shorter, golden hairs. Spots of frosting laterally on anterior pronotum (as well in middle of pronotum of macropterous form), and basal abdominal terga, on acetabula, and laterally on basal abdomina sterna. Antennae and legs with scattered pilosity of long, semierect hairs.

**Structural characters.** (Apterous ♂ (fig. 1): Body elongate, total length about 2.9x maximum width across thorax (4.15: 1.45). Head much shorter than wide across eyes (0.53: 0.90). Length of antennal seg-

ments (1-4): 0.93, 0.65, 0.55, and 0.50. Pronotum much longer than head (1.03), covering all of mesonotum, with posterior margin broadly rounded. Metanotum only visible as a triangular plate on each side of body, behind the pronotal lobe. Lengths of leg segments (femur, tibia, tarsus): fore leg: 1.03, 1.15, 0.39; middle leg: 1.58, 1.48, 1.16; hind leg: 1.88, 1.85, 0.69. Fore tibia on inner side before apex with slender, relatively short grasping comb (0.20); lengths of fore tarsal segments (1-3): 0.04, 0.05, and 0.30, claws long, hook-shaped. Middle femur moderately thickened; lengths of middle tarsal segments (1-3): 0.06, 0.35, and 0.75, last segment cleft for about three fourths of its length (figs. 1-2); claws flattened, asymmetrical, anterior claw sickle-shaped, abruptly narrow before pointed apex (fig. 2, ua, posterior claw curved, apex with long dorsal filament and narrow incision before pointed apex (fig. 2, up); ventral arolium with dorsal extension forming a swimming fan composed of a narrow stem with a row of long, dichotomously branching hairs arising from both sides (fig. 2). Hind trochanter with 4 small, black denticles

on lower surface; hind femur (fig. 3) strongly incrassate, width about 0.4x length, with ventral armature composed by two irregular rows of dark teeth; posterior row with 6 teeth in proximal part, the last two being the largest, and 9 teeth in distal part, the fourth one being much larger than the others; hind tibia curved throughout, inner margin with numerous small black denticles and a dark spine before apex; lengths of hind tarsal segments (1-3): 0.06, 0.15, and 0.48, last segment cleft for about two thirds of its length; claws flattened, asymmetrical, modified in the same manner as the claws of middle leg; ventral arolium forming a swimming fan similar to, but smaller, than that of the middle leg. Abdomen almost parallel-sided anteriorly, tapering posteriorly; abdominal mediotergites 1-2 tumose, tergites 3-7 depressed; connexiva (laterotergites) slightly raised, relatively broad, width more than half of width of corresponding mediotergite; posterior corners of connexival segment 7 provided with short, but distinct spines. Abdominal venter not modified, sternum 7 much shorter than sterna 5 and 6 together (0.38: 0.58), posterior margin almost straight. Genital segments relatively large; ventral surface of segment 8 simple, without median keel; proctiger widened basally and narrowed towards apex (fig. 4); parameres symmetrical, falciform, relatively broad at base which is furnished with a group of bristles (fig. 5).

Macropterous ♂. (Pronotum large, subpentagonate, slightly shorter than wide across humeral angles (1.45: 1.55); pronotal lobe raised in middle, posterior margin broadly rounded. Hind femur less incrassate and armature weaker than in apterous form. Fore wings barely reaching abdominal end when folded, each with four closed cells, two apical cells extends onto distal part of wing. Other characters as in apterous form.

Apterous ♀. (Body elongate, total length about 3.0x maximum width across thorax (4.40: 1.48). Head width (0.90). Length of antennal segments (1-4): 0.85, 0.60, 0.55, and 0.55. Lengths of leg segments (femur, tibia, tarsus): fore leg: 1.08, 1.10, 0.41; middle leg: 1.60, 1.43, 1.15; hind leg: 1.75, 1.70, 0.71. Fore tibia with grasping comb similar to, but much shorter (0.09) than that of ♂; lengths of fore tarsal segments (1-3): 0.04, 0.05, and 0.33. Middle femora moderately thickened; lengths of middle tarsal segments (1-3): 0.08, 0.33, and 0.75. Hind trochanter without denticles on lower surface; hind femur moderately incrassate (fig. 6), width about 0.3x length, with ventral armature similar to but weaker than in ♂; hind tibia almost straight, armature as in ♂; lengths of hind tarsal segments (1-3): 0.08, 0.16, and 0.48. Abdomen relatively narrow, tapering posteriorly; abdominal mediotergites 1-3 tumose, tergites 4-8 depressed; connexiva (laterotergites) obliquely

raised, relatively broad, width more than half of width of corresponding mediotergite; posterior part of laterotergite 4 with a tuft of long, dark hairs directed posteromedially; posterior corners of connexival segment 7 provided with short, but distinct spines (fig. 7). Abdominal venter not modified, sternum 7 much shorter than sterna 5 and 6 together (0.58: 0.70), posterior margin almost straight. Genital segments relatively large, gonocoxa ventrally exposed, slightly impressed (fig. 7); proctiger relatively narrow, protruding. Other characters as in apterous ♂.

Distribution. — Thailand (SW: Prachuab Khiri Khan Province).

Comparative notes. — Closely related to *T. borneensis* Zettel (1995) and, in particular, to *T. chinthe* J. Polhemus & D. Polhemus (1998), sharing the short, but distinct connexival spines, unmodified abdominal venter, and falciform and pointed parameres. Hind femora of male usually more incrassate in *T. zetteli* sp.n. and *T. chinthe* than in *T. borneensis*. In the two first mentioned species, the ventral armature of the hind femora has 2-3 large teeth in the posterior row and hind tibia distinctly curved throughout. The two species also share the presence of tufts of long, black hairs on female abdominal laterotergites 4. In both males and females of *T. chinthe* the hind trochanters have a distinct spine (largest in ♂), whereas males of *T. zetteli* sp.n. have only few dark denticles and females none. The armature of the male hind femur of the new species is composed by 10-12 small teeth and 2-3 distinctly larger teeth whereas *T. chinthe* has more teeth overall, but fewer distinctly larger ones. This is the first species of *Tetraripis* described from Thailand although Hecher (1998: 8) lists an 'undescribed species?' of this genus from Thailand (with reference to the Nico Nieser Collection, Tiel, The Netherlands).

### *Tetraripis ravana* Kirkaldy

*Rhagovelia ravana* Kirkaldy, 1901: 309 (descr.). Lectotype, macr. ♀ (designation by J. Polhemus & D. Polhemus 1998): Peradeniya, Sri Lanka (Snow Entomological Collection, University of Kansas).

*Rhagovelia ravana* Kirkaldy; Distant 1903-1904: 172 (descr., illustr.).

*Tetraripis ravana* (Kirkaldy); Lundblad 1936: 53-56, 58, 60, figs. 30-31, plate 12 (descr., illustr., key); Thirumalai & Dam 1996: 69 (key); J. Polhemus & D. Polhemus 1998: 127 (records).

Type locality. — Sri Lanka, Peradeniya.

Material examined. — SRI LANKA: 2♀ apt., Prov. of Uva, Westminster Abbey, 25 mis ESE Bibile, 7.iii.1962, Loc. 119: II, stream, Lund University Expedition 1962, Brinck - Andersson - Cederholm (ZMUL); 1♀ macr., Prov. of Uva,

Westminster Abbey, 25 mis ESE Bibile, 7.iii.1962, Loc. 119: IV, stream in narrow ravine, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♀ apt., Prov. of Uva, Monragala Mtn., Alt. 500 ft, 25 mis E Badulla, 7.iii.1962, Loc. 121: II, stream, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♀ apt., Centr. Prov., Stream 2 mis E Madugoda, 18 mis E Kandy, 12.iii.1962, Loc. 134, stream, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♀ apt., [Prov. of Uva], Monaragala, 2.vii.1970, P.B. Karunaratne (JTPC).

Descriptive notes. – Body length 3.6–4.0 (apt. ♀), 4.1 (macr. ♀); width (across thorax) 1.3–1.4 (apt. ♀), 1.6 (macr. ♀). Colour chiefly brownish. Pronotum brownish with numerous dark punctures; a longitudinal stripe in middle, pale yellowish. Antennae and legs not distinctly banded. Fore wings each with three elongate, whitish spots, the intermediate one less distinct than the others. Lateral frostings on abdominal mediotergites 2–3 very distinct; tergites 4–7 shiny (♀); connexiva brownish yellow, without distinct pale spots. Hind femur moderately incrassate, armed with two large, and several smaller teeth on ventral surface (both ♂ and ♀); hind tibia without preapical spine. Connexival spines not formed. Parameres symmetrical, slender falciform, apex blunt.

Distribution. – Sri Lanka (Central and Uva Provinces).

***Tetraripis asymmetricus* Polhemus & Karunaratne**

*Tetraripis asymmetricus* Polhemus & Karunaratne in Polhemus, 1979: 99–101, figs. 5–7 (descr., illustr.). Holotype, apterous ♂, Kitulgala, Sri Lanka (U.S. National Museum, Washington, D.C.).

*Tetraripis asymmetricus* Polhemus & Karunaratne; Thirumalai & Dam 1996: 67–69, fig. 1 (rec., illustr., key); J. Polhemus & D. Polhemus 1998: 126 (records).

Type locality. – Sri Lanka, Kitulgala.

Material examined. – SRI LANKA: 1 ♂ apt., W. Prov., Yongammulla, 3 mis E Yakkala, 18 mis NE Colombo, 19.i.1962, Loc. 4, under stones, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 3 ♀ apt., W. Prov., Labugama, 24 mis ESE Colombo, 21.i.1962, Loc. 17: IV, stream, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♂ 1 ♀ apt., S. Prov., Panangala, 1 mis NNE Galle, 28.i.1962, Loc. 31, stream, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♀ apt., W. Prov., Eduragalla, 5.5 mis W Horana, 17 mis WNW Ratnapura, 17.ii.1962, Loc. 89, stream (upper part), Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♂ 2 ♀ apt., Sabaragamuwa. Prov., Deerwood, Kurawita, 6 mis NNW Ratnapura, 18–21.ii.1962, Loc. 90:II:2, river, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♀ apt., Sabaragamuwa. Prov., Kitul-

gala, 21 mis N Ratnapura, 17.iii.1962, Loc. 152, small stream, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL); 1 ♀ macr., without locality, Lund University Expedition 1962, Brinck – Andersson – Cederholm (ZMUL). INDIA: 2 ♀ apt., India (S), Karnataka, Thamudi, Taluk distr., c. 900 m., loc. 14, small stream, 6.xi.1977, N.M. Andersen (ZMUC); 2 nymphs, India (S), Karnataka, Gersoppa (Jog Falls), c. 600 m., loc. 32, stream w rocks, 18–22.xi.1977, N.M. Andersen (ZMUC); 7 nymphs India (S), Mavingundi, 5 km from Jog Falls, c. 600 m., loc. 36, stream w rocks, 23.xi.1977, N.M. Andersen (ZMUC); 1 ♂ apt., India (S), Karnataka, Gersoppa (Jog Falls), c. 600 m., loc. 40, fast river, 23.xi.1977, N.M. Andersen (ZMUC).

Descriptive notes. – Body length 2.95–3.45 (apt. ♂), 3.0–3.45 (apt. ♀), 3.3 (macr. ♀); width (across thorax) 1.0–1.15 (apt. ♂), 1.05–1.2 (apt. ♀), 1.25 (macr. ♀). Colour yellowish and brownish. Pronotum brownish with numerous dark punctures. Antennae and legs not distinctly banded. Fore wings each with three elongate, whitish spots, the intermediate one indistinct. Lateral frostings on abdominal mediotergites 2–4 distinct; tergites 4–7 shiny (♀); connexiva brownish yellow, without distinct pale spots, but with dark outer corners (♀). Pilosity of antennae and legs sparse but long. Hind femur strongly incrassate, armed with 2–3 large, and several smaller teeth on ventral surface (both ♂ and ♀); hind tibia with large preapical spine. Connexiva of apt. ♂ with very short spines; connexiva of apt. ♀ distinctly raised, converging posteriorly and sometimes meeting above abdominal tergum. Genital segments of ♂ asymmetrical; parameres asymmetrical, plate-shaped, distally angulate; left paramere plainly visible from above.

Nymphs. – Nymphs pale yellowish, with several long, black bristles arranged in a characteristic pattern. Instar V: antennal segment 1 (7), antennal segment 2 (1), laterally on pronotum (1+1), laterotergites 1–6 (1+1), laterotergite 7 (2+2), mediotergites 1–7 (1+1), distally on fore (1), middle (4), and hind femora (7), outer margin of hind tibia (7), and hind tarsus (4). Middle tarsus one-segmented, deeply cleft, with swimming fan of similar structure as in adult; hind tarsus one-segmented, with shallow cleft and small swimming fan; length 2.4–2.6. Instar IV with fewer black bristles and only swimming fan on middle tarsus, length 1.7–2.0.

Distribution. – Sri Lanka (West, South, Central, Uva, and Sabaragamuwa Provinces), India (Karnataka, Tamil Nadu) (J. Polhemus 1979, Thirumalai & Dam 1996, J. Polhemus & D. Polhemus 1998). The record of *Tetraripis* mapped for South India by Andersen (1982: fig. 617) refers to this species.

*Chenevelia stridulans* Zettel

*Chenevelia stridulans* Zettel, 1996: 353-359, figs. 1-9 (descr., illustr., biol.). Holotype, apterous ♀, Phrae Province, Thailand (NHMW).

*Chenevelia stridulans* Zettel; Hecher 1998: 4, 8, 42, figs. 5-7 (key, illustr.).

Type locality. – Thailand, Phrae Province.

Material examined. – THAILAND: 1 ♀ apt., Chiang Mai Province, Doi Inthanon N.P., Mae Ya, 6-700 m., 11.x.1981, Zool. Museum Copenhagen Exp. (ZMUC).

Descriptive notes. – Total length 4.5 (apt ♂), 4.5-4.6 mm (apt. ♀), greatest width (across abdomen) 1.55 (apt. ♂), 1.7-1.75 (apt. ♀). Both male and female with stridulatory devices composed of a 'scraper' on connexival margin of abdominal sterna 2 and 3, and a 'file' on base of hind femur. Anterior margin of pronotum laterally with a narrow and deep incision. Prosternum in middle with a few short, dark hairs; anterior margin set with a row of about 6 hook-shaped, black, spinous hairs on each side (unique character not mentioned in the original description). Fore tibia of male with grasping comb which is 1.5x length of third segment of fore tarsus; hind femur of male incrassate, ventral surface with two large teeth and numerous smaller teeth; tibia strongly bent in distal third. Fore tibia of female with short grasping comb which is about 0.5x length of third segment of fore tarsus; hind femur of female moderately thickened, ventral surface with 1-2 large teeth and numerous smaller teeth. Last segment of middle tarsus deeply cleft, with asymmetrical claws and swimming fan similar to that of *Tetraripis* (fig. 2); last segment of hind tarsus also cleft and with claws and swimming fan similar to that of *Tetraripis* (fig. 3). Abdomen relatively broad, connexiva slightly raised, posterior corners of laterotergites pointed (apt. ♀).

Distribution. – Thailand (N: Phrae, Mae Hong Son, and Chiang Mai Provinces).

**Discussion**

When describing *Tetraripis*, Lundblad (1936) clearly indicated its close affinity with the genus *Rhagovelia*. This classification was formalized by China & Usinger (1949), who placed both genera in their subfamily Rhagoveliinae, and accepted by subsequent authors (J. Polhemus 1979, Andersen 1982). Recently, D. Polhemus (1997) has proposed that *Tetraripis* should be reassigned to the subfamily Veliinae. He regards the presence of a pretarsal fan ('swimming plume') in this genus and *Rhagovelia* as a case of parallelism (convergent evolution), based on differences in structural details of the fan (hairy vs. plumose) and presence of such structures on both

middle and hind legs in *Tetraripis*. D. Polhemus hypothesises that the pretarsal structures are the result of convergent evolution of an presumably adaptive (and therefore flexible) character and places greater emphasis on other characters of *Tetraripis* which in his opinion affiliates this genus with the subfamily Veliinae (such as the possession of a fore tibial grasping comb in the female and metasternal scent channels curving obliquely forwards).

Apparently, D. Polhemus (1997) treat the presence of a pretarsal fan as just one character. However, pretarsal structures forming swimming fans are in veliids usually formed by widening of the claws and flattening of the normally bristle-like ventral arolium (sometimes also the dorsal arolium) (Andersen 1982). In contrast, the rhagoveliine swimming fan is unique in several respects: the fan is inserted at the bottom of the deeply cleft last segment of the middle tarsus; it is a dorsal extension of the ventral arolium, not the arolium itself; and the claws are asymmetrically modified, blade-like. The mechanism of operation of the rhagoveliine swimming fan is also unique in that only one of the two claws is retracted when the fan is unfolded (for details, see Andersen 1976: 354). The detailed, unique similarity between the midtarsal swimming fan of *Rhagovelia* and *Tetraripis* (fig. 2) severely weakens the hypothesis of parallel evolution. That the fan of *Tetraripis* is composed by dichotomously branched hairs instead of plumose hairs and that a structurally similar fan is present on the hind tarsus cannot be used as evidence of parallelism. These features are merely autapomorphies of *Tetraripis* which probably have evolved after the structures shared with *Rhagovelia*.

The fore tibial grasping comb is a unique structure possessed by most veliid males. The comb is composed by a row of short, stout spines distally along the posterior, innermost margin of the fore tibia. A similar, although shorter, comb is observed on the fore tibia of female *Tetraripis* and of females belonging to the veliine genera *Angilia* Stål and *Stridulivelia* Hungerford (but not in other veliines, e.g., *Angilovelina* Andersen and *Velia* Latreille). The last mentioned character was used as an autapomorphy for the subfamily Veliinae by Andersen (1982: table 10 and fig. 357) and by D. Polhemus (1997) as evidence for reassigning *Tetraripis* to this subfamily. However, the parallel evolution in females of an otherwise exclusive male structure is far more likely than the convergent evolution of deeply cleft middle tarsi with unique pretarsal structures.

The structure of the metasternum, in particular the orientation of the lateral scent channels, was the second character used by D. Polhemus (1997) as argumentation for the inclusion of *Tetraripis* in the Veliinae. D. Polhemus (1997) treats the broad, flat, and

roughly chevron-shaped metasternum found in *Rhagovelia angustipes* Uhler and allied Neotropical species as primitive (plesiomorphic); in this state each of the lateral scent channels follows a more or less straight course from the midventral scent orifice to the evaporatorium on each metacetabulum (Andersen 1982: fig. 320). A compressed trapezoidal, and tumescent metasternum with scent channels curving obliquely forwards (see Andersen 1982: figs 318, 321) was inferred as the apomorphic state. However, when more outgroups (e.g., *Ocellovelia* China & Usinger, most microveliine genera, *Angilia*, and *Velia*) are considered, this polarisation is reversed. Therefore, the similarity between *Tetraripis* and veline genera is symplesiomorphic, not synapomorphic.

Most species of *Rhagovelia* are found skating on the surface of streams and small rivers. As far as we know, species of *Tetraripis* and *Chenevelia* live in more cryptic habitats, usually under stones and overhanging rocks in streams (Andersen 1982: 271, Zettel 1996: 358-359; J. Polhemus & D. Polhemus 1998: 123, 126), habitats where we also find many species of Veliinae, e.g., *Angilia* spp. as well as *Ocellovelia* spp. and many Microveliinae. The most parsimonious explanation, however, is that this type of habitat use is the most ancestral one within the Veliidae from which more advanced types have evolved (Andersen 1982).

Following the argumentation presented above, the reassignment of *Tetraripis* to the subfamily Veliinae as suggested by D. Polhemus (1997) is based on one questionable synapomorphy (female grasping comb) and one symplesiomorphy (metasternal structure). This should be contrasted with the evidence presented by several unique synapomorphies (structural details of the middle tarsus) shared by *Tetraripis*, *Chenevelia*, and *Rhagovelia*, which inevitably lead to the conclusion that the three genera are members of the same monophyletic taxon, the subfamily Rhagoveliinae.

In his excellent monograph of the genus *Rhagovelia* of the western hemisphere (exclusive of the *R. angustipes* complex), D. Polhemus presents the results of an analysis of the phylogenetic relationships between species groups. One of the key character used in this analysis is the state of development of the pronotum in apterous (wingless) adults. The most common structure is one where the posterior, free part of pronotum (the pronotal lobe) is less strongly arched, the humeral angles depressed, and the posterior margin broadly rounded, but still covering the mesonotum and usually also the median part of metanotum. In several groups of veliids (Haloveliinae, some Microveliinae and Rhagoveliinae), apterous individuals have completely lost the pronotal lobe and the pronotum is reduced to a narrow plate behind the head, exposing mesonotum as well as all of metanotum.

The polarization of different states of reduction of

the pronotum depends upon the choice of outgroups to compare with. The reduced pronotum of some apterous veliids was hypothesized to be the plesiomorphic state by D. Polhemus (1997). The most basal group of the Veliidae is represented by the genus *Ocellovelia* China & Usinger, 1949, with two described species which usually are macropterous, although brachypterous individuals (with short, but distinct wing rudiments) are known. However, in the rare apterous form of *Ocellovelia* (undescribed species from Zimbabwe; N. M. Andersen, unpublished) the pronotum is reduced, but still covers the entire mesonotum. This also applies to all members of the subfamilies Perittopinae and Veliinae, and the most basal lineages of the subfamily Microveliinae. The most parsimonious polarization of the states of reduction of the pronotum of apterous forms would therefore be a progression from a relatively long pronotum (with a pronotal lobe similar to but shorter than that of the macropterous form) to states of increasing shortening of the pronotal lobe until the pronotum is reduced to a narrow, transverse strip behind the head (see Andersen 1982: figs 270-273).

Pronotal reduction is (with some exceptions) followed by a trend towards modification and reduction of the most distal veins of the fore wing, associated with the evolution of autotomy (self-mutilation) of wings (Andersen 1982: figs 550-552). The unquestionable apomorphy of this state of wing venation lends support to the hypothesis of polarization of pronotal length presented above.

Following this argumentation, the reduced pronotum of the *Rhagovelia angustipes* group and species of the genus *Trochopus* most likely represents a relatively apomorphic state and not the most plesiomorphic state as suggested by D. Polhemus (1997). *Rhagovelia* species exhibiting pronotal reduction are also found in the paleotropics, e.g., in the *R. femorata* Dover group (*sensu* Lundblad 1936) from the Oriental region (= *R. sarawakensis* group *sensu* Polhemus & Polhemus 1988), the *R. novacaledonica* Lundblad group from New Caledonia, New Guinea, and the Philippines, and the *R. caesius* Lansbury group from New Guinea and the Philippines (Lundblad 1933, 1936, J. Polhemus & D. Polhemus 1988, Lansbury 1993, Zettel 1994, D. Polhemus 1995).

The genus *Trochopus* Carpenter (1898) was described for the marine *Rhagovelia marina* Carpenter, 1898 (junior synonym of *R. plumbea* Uhler, 1898) from the Caribbean. The species *T. salinus* Champion, 1898 (Pacific side of Panama), *T. ephydros* Drake & Van Doesburg 1966 (Suriname), *T. arcuatus* and *colombianus* J. Polhemus & del Rosario Manzano 1992 (Colombia), were subsequently added (for keys to species, see Drake & Van Doesburg 1966, J. Polhemus & del Rosario Manzano 1992). Apart from

being marine (*T. ephydros* probably eryhaline), these species differ by having only two segments in all tarsi (second segment formed by fusion of the primitive segments 2 and 3 in fore and hind legs, by fusion of the primitive segments 1 and 2 in middle leg; Andersen 1982: table 9), an extremely short pronotum, one instead of two micropyles in the egg (Andersen 1982: 136), and by the complete absence of macropterous forms (shared with other marine water striders). Neither Bacon (1956), Matsuda (1956), nor D. Polhemus (1997) recognized *Trochopus* as a valid genus since it most certainly is more closely related to the *Rhagovelia angustipes* Uhler group (see below) than to other *Rhagovelia*.

Matsuda (1956) erected the subgenus *Neorhagovelia* (type species: *Rhagovelia angustipes* Uhler, 1898) for those species of *Rhagovelia* which have an extremely reduced pronotum (apterous form) and reduced apical venation of the fore wings (and which practise autotomy of wings), and assigned to it all species contained in the *R. angustipes* and *abrupta* groups of Bacon (1956). The *R. angustipes* group (alternatively called the *R. bisignata* Bacon group by D. Polhemus 1997), is clearly monophyletic whereas the *R. abrupta* group probably is a paraphyletic grade (Polhemus & Polhemus 1988; D. Polhemus 1997). If retained as a valid taxon (see below), *Neorhagovelia* should therefore be redefined to only include the *R. angustipes* group (a list of species is provided by D. Polhemus 1997, Lansbury & D. Polhemus 1999). Likewise, the Philippine species of *Rhagovelia* included in *Neorhagovelia* by Hungerford & Matsuda (1961) should be excluded (J. Polhemus & D. Polhemus 1988, Zettel 1994).

Both *Trochopus* and *Neorhagovelia* are sufficiently distinct, both structurally and ecologically, to merit separate recognition, at least as subgenera. At present, the subgenus *Rhagovelia* s.str. is probably a paraphyletic entity as compared with *Trochopus* and *Neorhagovelia*. When a more comprehensive revision of the genus *Rhagovelia* becomes available, the more than 250 species of this genus may be partitioned into additional subgenera or placed in separate genera.

Thus, the present state of supraspecific classification of the subfamily Rhagoveliinae can be summarized as follows:

Genus *Chenevelia* Zettel, 1996

Genus *Rhagovelia* Mayr, 1865

Subgenus *Trochopus* Carpenter, 1898

Subgenus *Neorhagovelia* Matsuda, 1956

Subgenus *Rhagovelia* s.str. Mayr, 1865

Genus *Tetraripis* Lundblad, 1936.

In a cladogram of relationships between the sub-

families of Veliidae, Andersen (1982: fig. 357) placed Perittopinae + Veliinae as sister group of the Rhagoveliinae. This hypothesis, however, is not well founded since no synapomorphies uniting the Perittopinae and Veliinae can be found. Furthermore, the monophyly of the subfamily Veliinae is only supported by one character, the presence of a grasping comb on the female fore tibia (see above) which is only found in some veliine genera (Andersen 1982: 183). An alternative hypothesis is that the Veliinae is a paraphyletic group with respect to the Rhagoveliinae, meaning that the latter evolved from some subgroup of veliine genera of which the genera *Angilia* and *Angilovelina* are the most likely candidates. In any case, a female grasping comb must have evolved independently in the two subfamilies. Likewise, stridulatory devices of the same structure must also have evolved independently in *Chenevelia* (Rhagoveliinae), *Angilovelina y-alba* (Paiva), and in many species of *Sridulivelina* (Veliinae) (Andersen 1981, 1982). The relationships of *Perittopus* Fieber (Perittopinae) remain unsettled in both hypotheses outlined above. Further studies, preferably including molecular systematic characters, are needed to resolve the relationships between the Rhagoveliinae, Perittopinae, and the genera of Veliinae.

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## A REVISION OF THE CICADA GENUS *ORIENTOPSALTRIA* KATO (HOMOPTERA, CICADIDAE) FROM SOUTHEAST ASIA

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This revision of the genus *Orientopsaltria* contains a generic description, and descriptions, illustrations and distributional maps of the 24 species. Nine species are described as new to science: *O. angustata*, *O. confluens*, *O. hollowayi*, *O. kinabaluana*, *O. latispina*, *O. maculosa*, *O. palawana*, *O. vanbreei*, and *O. noonadani*. Five species are transferred to other genera: *O. divergens*, *O. montana*, and *O. tonkiniana* to *Platylomia*, *O. multivocalis* to *Meimuna*, and *O. cesloui* to *Dundubia*. One species of *Platylomia*, *P. fuliginosa*, is included in *Orientopsaltria*, and *Platylomia banqueyensis* Distant, 1912 is considered a junior synonym of *Orientopsaltria alticola* (Distant 1905). A key presented here is designed to identify the males of *Orientopsaltria* to the species level. The subdivision in species groups is based upon a preliminary phylogenetic analysis of the species of the genus. The genus *Orientopsaltria* is restricted to the Malayan Peninsula, Sumatra, Borneo, Palawan, and the Philippines. None of the *Orientopsaltria* species is distributed over the whole range of the genus. The highest percentage of endemics is found in the Philippines (4 species: 100% endemic) and Palawan (2: 100%), followed by Borneo (6: 50%), Sumatra (2: 25%) and the Malayan Peninsula (1: 10%). This study aims to contribute to the historic biogeographical study of the subtribe Dundubiaria of Southeast Asia and to the knowledge of cicada biodiversity in this area.

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Key words: – *Orientopsaltria*; Cicadidae; taxonomy; new species; key to species; phylogeny; distribution; Southeast Asia.

The taxonomy, phylogeny and biogeography of the cicadas occurring east of Wallace's Line, in Sulawesi, New Guinea and the West Pacific, has been the subject of several publications in the last two decades (Boer & Duffels 1997). One of the two major groups studied is the subtribe Cosmopsaltriaria of the tribe Dundubiini. The Cosmopsaltriaria range from Sulawesi through New Guinea to the Samoa Islands. Phylogenetic and biogeographic analyses of the 8 genera and 125 species of that group suggested that the ancestor of the Cosmopsaltriaria occurred in Northeast Asia and dispersed along island arcs to Sulawesi, New Guinea and the West Pacific in the mid-Tertiary (Boer & Duffels 1996).

Over the last few years the biogeographical study of the cicadas of Southeast Asia and the West Pacific has been focussed on the presumed sister group of the

Cosmopsaltriaria. This group probably consists of one or more genera of the Dundubiaria, a subtribe of the Dundubiini. From a biogeographical viewpoint it is interesting to note that the Dundubiaria are mainly distributed to the west of Wallace's Line: the Greater Sunda Islands and mainland of Southeast Asia. The taxonomy, phylogeny and biogeography of the subtribe Dundubiaria are currently studied by Beuk (1996, 1998, 1999). That author has already revised parts of *Dundubia* Amyot & Serville, 1843 (Beuk 1996) and *Platylomia* Stål, 1870 (Beuk 1998, 1999). The genus *Orientopsaltria* Kato, 1944 revised in this paper also belongs to the subtribe Dundubiaria. The results of the present study will be included in Beuk's forthcoming phylogenetic and biogeographic study of this subtribe.

This paper also aims to contribute to the knowledge of cicada biodiversity in Southeast Asia. The Centre for Insect Systematics of the Universiti Kebangsaan Malaysia in Bangi, Selangor, is one of the institutes that has been very active in recent years in executing cicada inventories in nature reserves and other areas in Peninsular Malaysia, as well as in the Bornean states of Malaysia, Sabah and Sarawak (e.g. Zaidi 1996, Zaidi & Hamid 1996). Our research in these areas has shown that the systematic knowledge of cicadas is insufficient to offer reliable identifications of the cicadas from the Malayan Peninsula and the Greater Sunda Islands (Zaidi 1996, Zaidi & Hamid 1996, Zaidi et al. 1996, Duffels & Zaidi 1998). Keys to all cicadas, based on descriptions and illustrations of the species, are needed. This basic systematic work is regarded as a prerequisite for further biodiversity studies on cicadas. Biodiversity studies of cicadas in other tropical areas, such as Sulawesi, New Guinea, and the West Pacific, have already shown that cicadas can be instrumental in recognizing hot spots of species richness and areas of endemism with unique biota (e.g. Duffels & Boer 1990, Boer & Duffels 1997).

#### HISTORY OF THE GENUS

The genus *Orientopsaltria* was erected by Kato (1944a) for two species of the genus *Cosmopsaltria* Stål, 1866 with rounded instead of spine-like pygofer lobes, viz., *C. duarum* (Walker, 1857), the type-species of the new genus, and *C. jacoona* Distant, 1888. Kato (l.c.) regarded spine-like lobes as found in the two Papuan species *Cosmopsaltria doryca* (Boisduval, 1835), the type species of *Cosmopsaltria* Stål, 1866, and *C. lata* (Walker, 1868), as a characteristic feature for *Cosmopsaltria*. Soon after, Kato (1944b, 1956) transferred four more species from *Cosmopsaltria* to *Orientopsaltria*, viz., *C. montivaga* (Distant, 1889), *C. feae* Distant, 1892, *C. montana* Kato, 1927 and *C. multivocalis* Matsumura, 1917. And in 1968 Duffels included *C. agatha* Moulton, 1911 in *Orientopsaltria*.

In 1983, Duffels proposed a new concept for *Cosmopsaltria* in his revision of this genus. The species with spine-like lateral pygofer lobes were assembled in *Cosmopsaltria*, while 17 *Cosmopsaltria* species with rounded pygofer lobes were transferred to *Orientopsaltria*. The 23 species at the time assigned to *Orientopsaltria* were preliminarily classified in two species groups: one group of six species with a globose head like in *Dundubia* and unicoloured male opercula, and another group of 17 species with a less globose head and bi- or multi-coloured male opercula (Duffels 1983). In 1996, Beuk transferred the six species of the first group to the genus *Dundubia*, and created the

'*Dundubia jacoona* assemblage' to accommodate these species. Consequently, the second group constituted the genus *Orientopsaltria* and consisted of the following 17 species: *agatha*, *alticola* (Distant, 1905), *brooksi* (Moulton, 1923), *cesloui* (Lallemand & Synave, 1953), *divergens* Distant, 1917, *duarum*, *guttigera* (Walker, 1856), *ida* (Moulton, 1911), *inermis* (Stål, 1870), *montana*, *montivaga*, *moultoni* (China, 1926), *multivocalis*, *padda* (Distant, 1887), *phaeophila* (Walker, 1850), *sumatrana* (Moulton, 1917), and *tonkiniana* Jacobi, 1905. Only recently, two species new to science were described in the genus: *Orientopsaltria ruslani* Duffels & Zaidi, 1998 and *O. saudara-padda* Duffels & Zaidi, 1998.

According to the present state of the literature a total of 19 described species are assigned to *Orientopsaltria*. Preliminary phylogenetic investigations of the subtribe Dundubiaria, however, show that five of these species should be transferred to other genera: *C. divergens* Distant, 1917, *C. montana*, and *C. tonkiniana* Jacobi, 1905 to *Platylomia*, *C. multivocalis* to *Meimuna* Distant, 1905, and *O. cesloui* to *Dundubia* (Beuk in prep.). On the other hand the present revision shows that *Platylomia fuliginosa* (Walker, 1850) belongs to *Orientopsaltria*, and that *Platylomia banqueyensis* Distant, 1912, is a junior synonym of *Orientopsaltria alticola* (Distant, 1905). Due to these transfers, the number of species of the genus was decreased to 15, but the description of nine species new to science in this revision brings the total of *Orientopsaltria* species up to 24.

The history of the species of *Orientopsaltria* goes back much further than 1944, the year *Orientopsaltria* was described. Two species here assigned to *Orientopsaltria*, *Dundubia fuliginosa* from the Philippines and *D. phaeophila* from 'Corea' (see comments following the description of that species), were already described in 1850 by Francis Walker in his 'List of Homopterous Insects in the Collection of the British Museum'. Some years later, the same author described two other species now attributed to *Orientopsaltria*, after material collected by Alfred Russel Wallace: *Dundubia guttigera* from Singapore (1856), and *Dundubia duarum* from Sarawak, Borneo (1857). In 1870, Stål published his excellent study of the Hemiptera of the Philippines, which included a description of the new species *Cosmopsaltria inermis*. At the end of the 19th century W. L. Distant contributed considerably to the study of the cicadas of the Oriental region by the publication of 'A monograph of Oriental Cicadidae' (1889-1892), which is still considered to be a classic work in cicada taxonomy. In publications preceding his monograph Distant had already described *Cosmopsaltria padda* from Penang, in 1887, and *Cosmopsaltria montivaga* from

Mount Kinabalu, Borneo, in 1889. And several years later, in 1905, he described another species from Mount Kinabalu, *Cosmopsaltria alticola*.

J. C. Moulton, director of the Raffles Museum, Singapore for several years, was the most dedicated student of the cicadas of the Greater Sunda Islands and the Malayan Peninsula. He described four new species now assigned to *Orientopsaltria*, viz., in 1911 *Cosmopsaltria agatha* and *C. ida* from Sarawak, in 1917 *C. sumatrana* from Sumatra, and in 1923 *C. brooksi* from Sumatra. The 1923 paper is his well-known overview 'Cicadas of Malaysia' that still provides an excellent basis for systematic studies of the cicadas of the Greater Sunda Islands (Java, Sumatra and Borneo) and the Malayan Peninsula up to the isthmus of Kra. His paper provides a list of species from this area, keys for the identification to genus and species levels, and descriptions of new genera and species, while references are given to descriptions by earlier authors. Moulton treated 13 species of *Cosmopsaltria* from Sumatra, Borneo and the Malayan Peninsula, four of which were attributed to the *Dundubia jacoona* assemblage (Beuk 1996), and the remaining nine species are now included in *Orientopsaltria*.

In the introductory chapters of 'Cicadas of Malaysia', Moulton (1923) discussed the potential value of male genitalia for the distinction and classification of cicadas, with reference to the first drawings

of male genitalia of cicadas of the United States (Davis 1916). The paper by Moulton & China (1926), published after Moulton's death, gives drawings of the uncus and the male pygofer of several species of Malaysian cicadas. These figures were probably added by the second author, who also added the description of the new species *Cosmopsaltria moultoni*, which had already been recognised by Moulton as new to science. In the meantime Singh Pruthi (1925) had published his paper on the morphology of the male genitalia in Rhynchota with several rather poor drawings of male genitalia of cicadas, including those of *D. guttigera* and *C. montivaga*. Nowadays, the male genitalia are very important in cicada systematics, not only for the distinction of the species, but also in the study of phylogeny.

#### PHYLOGENY

The subtribe Dundubiaria of the tribe Dundubiini is currently revised by Beuk (1996, 1998, 1999) with the primary aims to reconstruct the phylogeny of the subtribe and to investigate the phylogenetic relationships between the Dundubiaria and the subtribe Cosmopsaltriaria. The subtribe Dundubiaria or, more likely, one or more genera or species groups of this subtribe, form the alleged sister group of the monophyletic subtribe Cosmopsaltriaria. The latter subtribe formed the subject of taxonomic and biogeo-

Table 1. Character state matrix of the species of *Orientopsaltria* and *Platylomia spinosa*

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>P. spinosa</i>	1	2	3	-	-	2	3	2	3	1	3	1	1	2&3	2	9	?
<i>montivaga</i>	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	?
<i>ruslani</i>	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	8	?
<i>agatha</i>	3	1	1&2	2	1	1	1	2	2	1	1	1	1	1	2	3	?
<i>padda</i>	1	1	1	2	1	1	3	2	2	1	3	1	1	2	2	2	1
<i>saudarapadda</i>	1	1&2	1	2	2	1	3	2	2	1	3	1	1	2	2	2	1
<i>moultoni</i>	3	1	1&2	2	2	1	3	2	2	1	1	1	1	2	2	2	1
<i>duarum</i>	1	1	1	2	1	1	3	2	2	1	3	1	1	2	2	7	?
<i>brooksi</i>	1	2	1	1	1	1	3	2	2	1	3	1	1	2&3	2	2	1
<i>guttigera</i>	2	2	2	1	1	1	2	2	3	1	3	1	1	2	2	2	2
<i>angustata</i>	2	2	2	1	1	1	2	2	3	1	3	1	1	2	2	2	2
<i>phacophila</i>	2	2	2	1	1	1	2	2	3	1	2	1	1	2	2	2	2
<i>maculosa</i>	2	2	2	1	1	1	2&3	2	3	1	3	1	1	2	2	2	1
<i>hollowayi</i>	2	2	2	1	1	1	2	2	3	1	3	1	1	2	2	2	1
<i>ida</i>	1	2	2	1	1	1	3	2	1	1	3	1	1	2	2	4	?
<i>palawana</i>	1	2	2	1	1	1	2	1	1	1	3	1	1	2	2	4	?
<i>sumatrana</i>	1	2	2	1	1	1	3	2	1	2	3	1	3	3	2	6	?
<i>vanbreei</i>	1	2	2	1	1	1	3	2	1	1&2	3	1	3	3	2	6	?
<i>kinabaluana</i>	1	2	2	1	2	1	3	2	3	2	3	1	1&2	3	2	5	?
<i>alticola</i>	3	1	2&3	1	1	1	3	1	3	2	3	2	2	3	2	5	?
<i>fuliginosa</i>	2	1	2	1	1	1	3	1	2	2	3	2&3	2	3	2	5	?
<i>latispina</i>	2	1	2	1	1	1	3	1	2	2	3	2	2	3	2	5	?
<i>inermis</i>	1	1	2	1	1	1	3	1	3	2	2	1	2	3	2	5	?
<i>confluens</i>	1	1	2	1	1	1	3	1	2	2	2	1	2	3	2	5	?
<i>nooadani</i>	2	1	2	1	2	1	3	1	3	2	3	3	2	3	2	5	?

graphic studies by Duffels (e.g. 1977, 1983, 1986, Boer & Duffels 1997). The phylogenetic relationships of the taxa of the two subtribes are of particular interest from a biogeographic point of view, because the Dundubiaria are mainly found in the mainland of Southeast Asia, the Greater and Lesser Sunda Islands, and the Philippines, while the Cosmopsaltria occur in Sulawesi, the Moluccas, New Guinea and the Southwest Pacific.

### The phylogenetic position of *Orientopsaltria*

A preliminary phylogenetic analysis of the Dundubiaria (Beuk pers. comm.) suggests a monophyletic origin of *Orientopsaltria*. For the moment we regard the brown to black coloration along the medial and apical margins of the male operculum as an apomorphy for this genus. This feature is not unique for *Orientopsaltria*, since it is also found in some species of *Platylomia*, another large genus of the same subtribe. A similar coloration of the male operculum is found in the Cosmopsaltria, viz., in some species of *Cosmopsaltria* and *Dilobopyga* Duffels, 1977.

### Infrageneric relationships

The main purpose of the preliminary phylogenetic analysis of the species of *Orientopsaltria* presented here is the subdivision of the genus in species groups. Preliminary analysis of the subtribe Dundubiaria shows that the genus *Platylomia*, the genus *Dundubia* or a species group in one of these genera constitute the sister group of *Orientopsaltria* (Beuk pers. comm.). However, the genus *Dundubia* is less suitable as outgroup since the external features of the body show some apomorphies that are not found in *Orientopsaltria*. We have selected *Platylomia spinosa* (Fabricius, 1787) as outgroup, because the structure of the male uncus is very similar to that *Orientopsaltria*. The characters used in the analysis are listed below. The character state matrix is presented in table 1. Awaiting further phylogenetic study of the Dundubiaria, we refrain from discussing the characters used in the analysis.

### Characters

1. Lower part of postclypeus: unmarked (1), with narrow median line in at least some specimens (2), with distinct dark mark at clypeal suture (3)
2. Pronotum: with a pair of dark lines or marks posterior of the eyes at innersides of lateral parts of ambient fissure (1), without such dark lines or marks (2)
3. Lateral mesonotal fasciae: reaching to anterior margin of mesonotum (1), not reaching anterior margin of mesonotum (2), absent (3)

4. Lateral mesonotal fasciae: narrower than distance between lateral and paramedian fasciae (1), as wide as or broader than distance between lateral and paramedian fasciae (2)
5. Black to dark brown colour along medial and apical margins of male operculum: strongly contrasting with lighter colour of rest of operculum (1), not strongly contrasting (2)
6. Male operculum: with black to black-brown colour along medial and apical margins (1), without black to black-brown colour along medial and apical margins (2)
7. Male operculum: with fairly narrow, distinct transverse fascia, just below constriction of operculum (1), with broad, sometimes vague, transverse fascia at half or two thirds of its length (2), without transverse fascia (3)
8. Male operculum: with white waxy area at apical margin (1), without white area at apical margin (2)
9. Tegmina: without infuscations (1), with infuscations at the bases of the 2nd, and 3rd and sometimes 5th apical areas (2), with infuscations at the bases of the 2nd, and 3rd and sometimes 5th and 7th apical areas, and infuscations at the apices of the longitudinal veins (3)
10. Timbal covering: broad; opening between operculum and timbal covering narrow, (much) less than half as wide as timbal covering (1), narrow; opening between operculum and timbal covering broad, at least half as wide as timbal covering (2)
11. Basal pygofer lobes forming: high parallel ridges (1), low parallel ridges (2), outcurved ridges (3)
12. Lateral pygofer lobes: rounded (1), weakly pointed (2), with nipple-shaped protrusions (3)
13. Uncus: with large and distinctly globose basal part (1), with small and weakly globose basal part (2), with a very narrow, not globose basal part (3)
14. Uncus: with cap over apex of aedeagus (1) with strongly to fairly strongly outcurved ridge over apex of aedeagus (2), with weakly elevated, laterally incurved ridge over apex of aedeagus (3)
15. Uncus lobes: with distinctly separated anterior (ventral) and posterior (dorsal) lobe (1), with posterior lobe only (2)
16. Posterior uncus lobes: fairly small and narrowing to incurved apex (1), broad with straight or outcurved lateral spine and short, hook-shaped medial spine (2), fairly small with fairly long, narrowing lateral spine and shorter, hook-shaped medial spine (3), broad with fairly broad lateral spine and fairly broad medial spine, both spines pointing laterally (4), broad with oblique or broadly rounded apical margin, and parallel lateral margins forming short, subapical or lateral spines (5), long, narrow and parallel sided (6),

- large and broad at base, strongly narrowing to in curved apex, and with lateral tooth (7), fairly broad and abruptly narrowing to sharply pointed apex (8), large and broad at basis and apex (9)
17. Uncus as in 16 (2) and with lateral spine: straight or outcurved and gradually tapering to apex (1), outcurved and strongly narrowing (2)

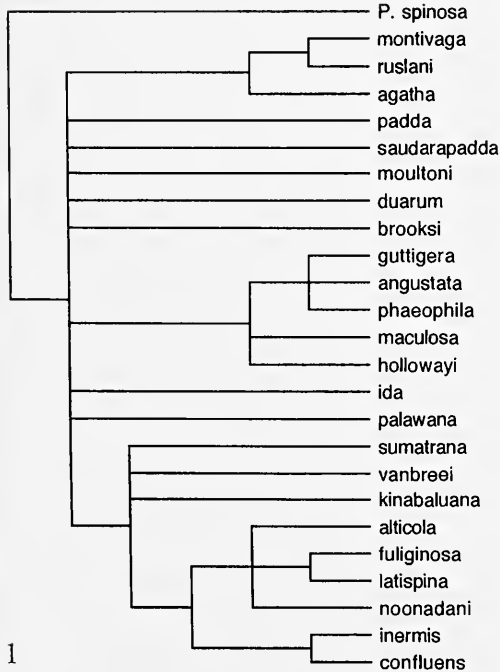
## Results

The analysis in PAUP 4.0 (heuristic search; multi-state characters interpreted as polymorphism; 500 replicates; seed 1) of the 17 unordered characters (table 1) of the 24 species of *Orientopsaltria* as in-group and *Platylomia spinosa* as outgroup resulted in 3504 shortest trees of 56 steps. Figs. 1 & 2 give the strict consensus tree (consistency index 0.583, retention index 0.681, and rescaled consistency index 0.397) and the 50% majority consensus tree (consistency index 0.750, retention index 0.851, and rescaled consistency index 0.638). They show the monophyly of 9 partly boxed groups, which are indicated by 100 (%) in the 50% majority tree. The results of the phylogenetic analysis of the species of

*Orientopsaltria* presented here are to a large extent determined by the choice of the outgroup. Analysis of *Orientopsaltria* with a different outgroup from other species groups of *Platylomia* or from other genera of the Dundubiini will give a more or less different results. However, our present knowledge of the Dundubiini indicates that the following characters will be recognised as synapomorphies independent of the outgroup that is used in the analysis:

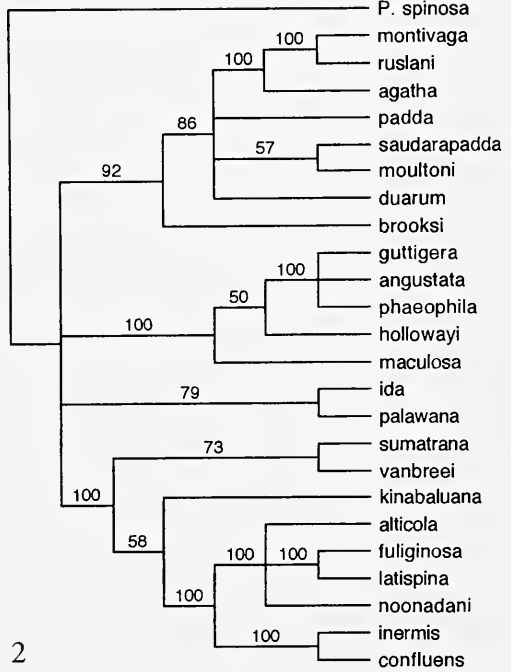
- male operculum with fairly narrow, distinct transverse fascia, just below constriction of operculum (7.1), and uncus in the male genitalia with cap over apex of aedeagus (14.1) for the *montivaga* group,
- male operculum with broad, sometimes vague, transverse fascia at half, or two thirds, of its length (7.2) for the *guttigera* group,
- lateral spine of posterior uncus lobe outcurved and strongly narrowing (17.2) for *O. guttigera*, *O. angustata*, and *O. phaeophila*;
- male operculum with very narrow to broad, white, area along apical margin (8.1) for the *alticola* group.

Strict



1

Majority rule



2

Figs. 1, 2. Consensus trees for the 1752 shortest trees (55 steps) for the species of *Orientopsaltria* with *Platylomia spinosa* as outgroup. – 1, strict consensus tree; 2, 50% majority consensus tree; the figures indicate the percentage of the shortest trees sustaining the branch.

CLASSIFICATION

We propose the following infrageneric classification of *Orientopsaltria*: the *montivaga*, *guttigera* and *alticola* groups, since these groups are supposed to be monophyletic according to the strict consensus tree (fig. 1); the *sumatrana* group and the *ida* group, which appeared to be monophyletic in more than 50% of the 3504 trees (fig. 2); the singletons *O. brooksi* and *O. kinabaluana* each in their own group; and the remaining species *O. padda*, *O. saudarapadda*, *O. moultoni*, and *O. duarum*, united more or less arbitrarily in the *padda* group.

In the systematic part of this paper we have arranged the species groups and the species in the following sequence:

Checklist of *Orientopsaltria*

*padda* group

*duarum* (Walker, 1857)

*padda* (Distant, 1887)

*saudarapadda* Duffels & Zaidi, 1998  
*moultoni* (China, 1926)

*montivaga* group

*montivaga* (Distant, 1889)

*ruslani* Duffels & Zaidi, 1998

*agatha* (Moulton, 1911)

*brooksi* group

*brooksi* (Moulton, 1923)

*guttigera* group

*angustata* sp. n.

*guttigera* (Walker, 1856)

*phaeophila* (Walker, 1850)

*maculosa* sp. n.

*hollowayi* sp. n.

*ida* group

*ida* (Moulton, 1911)

*palawana* sp. n.

Table 2. Distribution of the species of *Orientopsaltria*.

	Malayan Pen.	Sumatra	Borneo				Palawan	Philippines
			Sarawak	Sabah	Kalimantan	Brunei		
<i>duarum</i>	●	●	●	●	●	—	—	—
<i>padda</i>	●	●	●	●	●	—	—	—
<i>saudarapadda</i>	●	—	—	—	—	—	—	—
<i>moultoni</i>	—	●	—	—	—	—	—	—
<i>montivaga</i>	—	—	●	●	●	●	—	—
<i>ruslani</i>	●	● <sup>2</sup>	—	—	—	—	—	—
<i>agatha</i>	—	—	●	●	●	●	—	—
<i>brooksi</i>	●	●	—	—	—	—	—	—
<i>angustata</i>	—	—	●	—	●	—	—	—
<i>guttigera</i>	●	●	—	—	—	—	—	—
<i>phaeophila</i>	●	—	—	●	●	●	—	—
<i>maculosa</i>	—	—	●	●	●	●	—	—
<i>hollowayi</i>	—	—	●	●	—	—	—	—
<i>ida</i>	●	—	●	●	●	●	—	—
<i>palawana</i>	—	—	—	—	—	—	●	—
<i>sumatrana</i>	—	●	—	—	—	—	—	—
<i>vanbreei</i>	●	●	●	—	—	—	—	—
<i>kinabaluana</i>	—	—	—	●	—	—	—	—
<i>alticola</i>	●	—	●	●	●	●	—	—
<i>inermis</i>	—	—	—	—	—	—	—	—
<i>confluens</i>	—	—	—	—	—	—	—	—
<i>fuliginosa</i>	—	—	—	—	—	—	—	—
<i>latispina</i>	—	—	—	—	—	—	—	—
<i>noonadani</i>	—	—	—	—	—	—	● <sup>2</sup>	—
Number of species	10	8	10	10	9	6	2	4

<sup>1</sup> also Thailand?

<sup>2</sup> including Balabac and Busuanga

**sumatrana group***sumatrana* (Moulton, 1917)*vanbreei* sp. n.**kinabaluana group***kinabaluana* sp. n.**alticola group***alticola* (Distant, 1905)*inermis* (Stål, 1870)*confluens* sp. n.*fuliginosa* (Walker, 1850)*latispina* sp. n.*noonadani* sp. n.**DISTRIBUTION**

The genus *Orientopsaltria* is found in the Malayan Peninsula, Sumatra, Borneo, Palawan, and the Philippines. In the Malayan Peninsula the genus does not occur farther north than the Malaysian border, with the exception of *O. padda*, which has been recorded from the province of Chantaburi in south-

eastern Thailand. Incidental records of species from 'Java' and 'China' are regarded as highly questionable.

The distribution of all the species of *Orientopsaltria* is given in table 2, while distributional maps of the species are given in the systematic part of this paper. The highest number of *Orientopsaltria* species has been recorded from the island of Borneo (12), while lower numbers are found in the Malayan Peninsula (10), Sumatra (8), the Philippines (including Basilan Island in the Sulu Archipelago) (4) and Palawan (including Busuanga and Balabac) (2). The percentage of endemics is highest in the Philippines (4: 100%) and Palawan (2: 100%), followed by Borneo (6: 50%), Sumatra (2: 25%) and the Malayan Peninsula (1: 10%) (see table 2). None of the *Orientopsaltria* species is distributed over the whole range of the genus, but 3 species occur in the Malayan Peninsula, Borneo and Sumatra, 3 species are restricted to the Malayan Peninsula and Borneo, and 3 species to the Malayan Peninsula and Sumatra (fig. 3). Some species have very restricted distributions: *O. kinabaluana* has been found in western Sabah only, and *O. hollowayi* seems to be restricted to Sarawak and

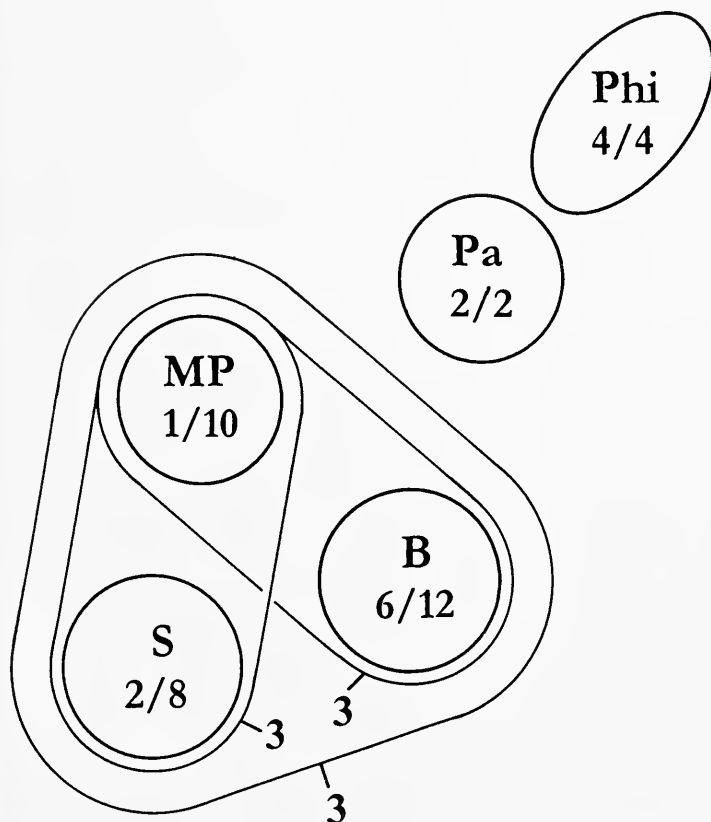


Fig. 3. Schematic figure of the distribution of the species of *Orientopsaltria* (B= Borneo; MP Malayan Peninsula; Pa= Palawan; Phi= Philippines; S= Sumatra; 1/10 means: 1 of the 10 species is endemic).

Sabah. *O. duarum* has a interesting distribution in western Borneo, along the east coast of Sumatra and in the southwestern part of the Malayan Peninsula. Interesting vicariant distributions are shown by the sister species *O. montivaga* from Borneo and *O. ruslani* from the Malayan Peninsula and Sumatra, and by the closely related species *O. angustata* from the southwestern part of Borneo, and *O. phaeophila* from the northeastern part of that island and from the Malayan Peninsula.

The taxon areacladogram (fig. 5) shows that the *montivaga*, *padda*, *guttigera*, and *sumatrana* groups have a wide distribution in the Malayan Peninsula, Sumatra and Borneo, while the *guttigera* group is concentrated in Borneo. The *alticola* group contains 4 species endemic to the Philippines, one species endemic to Palawan and the adjacent Busuanga and Balabac islands, and one species from the Malayan Peninsula and Borneo. The *ida* group is recorded from the Malayan Peninsula, Borneo, and Palawan.

We refrain from further speculations on the historic biogeography of the genus since we expect that

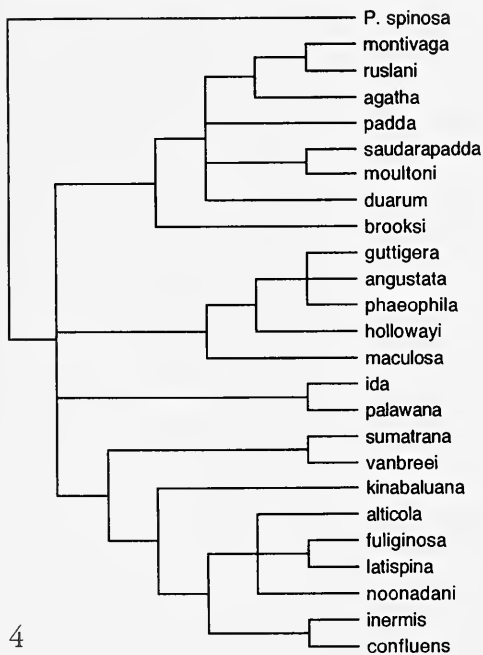
the forthcoming phylogenetic analysis of the whole tribe Dundubiini (Beuk in prep.) will provide a better phylogenetic basis for biogeographic reconstructions.

#### MATERIAL AND METHODS

The abbreviations given below for the institutions which are the depositories of the material studied, have been used in the lists of material and throughout the text:

BMNH	Natural History Museum, London (former British Museum (Natural History))
BIBM	Bernice P. Bishop Museum, Honolulu
CAS	California Academy of Sciences, San Francisco, California
CUIC	Cornell University Insect Collection, Department of Entomology, Ithaca, New York
HNHM	Zoological Department, Hungarian Natural History Museum, Budapest
KBIN	Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussel
MCZ	Museum of Comparative Zoology, University, Cambridge, Massachusetts
MNP	Muséum National d'Histoire Naturelle, Paris

50% majority consensus tree *Orientopsaltria*



taxon areacladogram *Orientopsaltria*

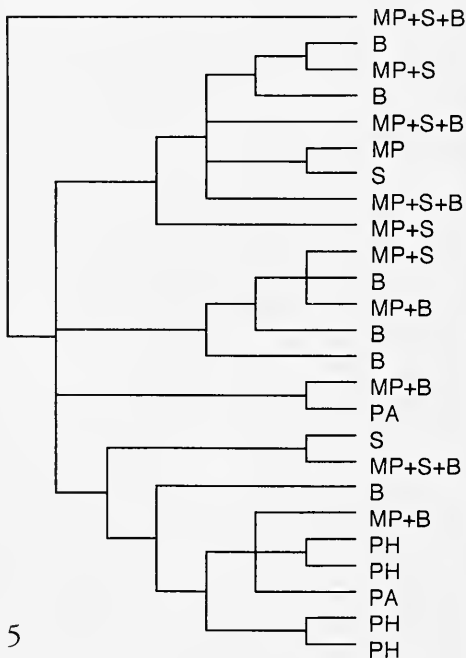


Fig. 4. 50% Majority consensus tree for *Orientopsaltria*.

Fig. 5. Taxon areacladogram for *Orientopsaltria* (B= Borneo; MP= Malayan Peninsula; PA= Palawan; PH= Philippines; S= Sumatra).

MNKM	Muzium Negara Malaysia, Kuala Lumpur
MSK	Muzium Sarawak, Kuching
MZHF	Zoological Museum, Finnish Museum of Natural History, Helsinki
NHMW	Naturhistorisches Museum, Wien
NHRS	Naturhistoriska Riksmuseet, Stockholm
NMW	National Museum of Wales, Cardiff
NSMT	National Science Museum (Natural History), Tokyo
OPU	Osaka Prefecture University, Osaka
PMS	Prirodoslovni Muzej Slovenije, Ljubljana
RMNH	Nationaal Natuurhistorisch Museum (former Rijksmuseum voor Natuurlijke Historie), Leiden
ROME	Royal Ontario Museum, Toronto, Ontario
SEM	Snow Entomological Museum, Lawrence, Kansas
UKM	Pusat SistematiK Serangga, Universiti Kebangsaan Malaysia, Bangi
UMS	University of Malaysia Sabah, Kota Kinabalu, Malaysia
UZMK	Universitets Zoologiske Museum, København
ZFMK	Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn
ZMA	Zoologisch Museum, Universiteit van Amsterdam, Amsterdam
	Moulds Private collection Mr M. S. Moulds, Greenwich, Australia

The localities and other data on the labels of the specimens studied for this revision were filed in a File-Maker Pro 4.0 database. The maps for the species distributions were printed from this database with the programme MapInfo for Power Mac, version 4.0.3 on maps of ADC-Worldmap version 2.0 vol. 4 Southern Asia & Australia.

The following geographical sources have been used for tracing the co-ordinates of the localities: 'Aardrijkskundig Woordenboek van Nederlandsch Oost-Indië' (Dumont 1917), 'Atlas van Tropisch Nederland' (Anonymous 1938), 'Gazetteer Nasional Nama-Nama Geografi' voor Indonesië (Anonymous 1978), 'Malaysia, Singapore & Brunei, the Rough Guide' (Ledesma et al. 1994), 'Malaysian Plant Collectors and Collections being a Cyclopaedia of Botanical Exploration in Malaysia' (Steenis-Kruseman 1950), Nelle's Road Atlas for Southeast Asia excluding Indonesia, and for Indonesia (Anonymous 1992a, b), 'The Times Atlas of the World' (Anonymous 1994), and the GEONet Names Server of the U.S. Defense Mapping Agency (<http://www.nima.mil/gns/html/index.html>).

The authors have seen several species alive, but all descriptions were made from collection material. Consequently the ground colour of the body is often described as brownish or light brown, but living spec-

imens of most species are rather greenish or brown with a greenish tinge.

#### TAXONOMIC PART

#### Genus *Orientopsaltria* Kato

*Orientopsaltria* Kato, 1944a: 6. Type-species by original designation: *Dundubia duarum* Walker, 1857.

*Orientopsaltria*; Kato 1956: 67, 76, 95; Overmeer & Duffels 1967: 31; Duffels 1977: 23, 24, 214, 218; Holloway 1979: 235; Duffels 1983: 3, 4, 9-11; Duffels & Van der Laan 1985: 119; Beuk 1996: 129, 130; Beuk 1998: 147; Duffels & Zaidi 1998: 320-321; Beuk 1999: 2.

#### Diagnosis

Medium-sized to fairly large cicadas: body length male: 27.5-43 mm, female: 24.5-37 mm. Head dorsally with median black mark enclosing ocelli. Postclypeus fairly strongly produced; rostrum variable in length from just reaching to distinctly passing hind coxae. Pronotum including pronotal collar distinctly wider than head; mesonotum narrower than Head. – Pronotum with a pair of central fasciae, mesonotum usually with five black fasciae: a median fascia, a pair of paramedian, and a pair of lateral fasciae, but lateral fasciae sometimes absent, and a pair of black spots in front of anterior angles of cruciform elevation. Tegmina and wings hyaline, tegmina either without infuscations, or with only two infuscations at the bases of the 2nd and 3rd apical areas, or with a more or less developed pattern of infuscations at the bases of the 2nd, 3rd, 5th and 7th apical areas, at the apices of the longitudinal veins of apical areas 2-6, and at the apices of the cubital veins CuA1 and CuA2. Male operculum elongate, reaching 5th to 7th abdominal segment, operculum black to dark brown along medial and apical margins. Male and female abdomen dorsally often with dark marking, but in some species more or less unicolorous, and ventrally more or less unicolorous, though often darkening distad, and with some black marking. Lateral lobes of male pygofer apically rounded or more or less distinctly protruded, basal part of uncus very narrow and flat to large and distinctly globose, uncus lobes variable in shape, and aedeagus without appendages.

#### Key to the species of *Orientopsaltria*

Remark: This key has been designed for identification of the males in the first place, since the females of six species of the genus (*O. duarum*, *moultoni*, *agatha*, *brooksi*, *hollowayi*, and *confluens*) are unknown. The key is therefore of limited value for the identification of the females.

1. Tegmina with macular infuscations .....2
- Tegmina without macular infuscations.....25
2. Mesonotum with paramedian fasciae (fig. 6) ....3
- Mesonotum with paramedian obconical marks (fig. 77). Borneo ..... *hollowayi*
3. Mesonotum with three black fasciae: a median fascia and a pair of paramedian fasciae; lateral fasciae absent or very obsolete. Male pygofer as in fig. 113. Malayan Peninsula, Borneo ..... *alticola*
- Mesonotum with five black fasciae: a median, a pair of paramedian fasciae, and a pair of lateral fasciae.....4
4. Lateral fascia on mesonotum long, reaching to anterior margin of mesonotum, though sometimes narrowing anteriorly (fig. 10) .....5
- Lateral fasciae on mesonotum fairly long to short, not reaching anterior margin of mesonotum (fig. 56) .....10
5. Pronotum with black to black-brown lateral marks or fasciae at innerside of lateral parts of ambient pronotal fissure (fig. 37); the fasciae may continue on the pronotal collar. Body length male: 32-41.5 mm.....6
- Pronotum without such dark lines or marks (fig. 51). Body length male: 27.5-30.5 mm. Sumatra ..... *brooksi*
6. Pronotum with black to black-brown lateral fasciae, running from eye along innersides of lateral parts of ambient pronotal fissure and across pronotal collar to posterior margin of pronotal collar (figs. 6, 10) .....7
- Pronotum with short, black to black-brown lateral marks or fasciae at innersides of lateral parts of ambient pronotal fissure, that do not continue on pronotal collar .....8
7. Lateral pronotal fasciae running from eyes to bases of tegmina (fig. 10). Malayan Peninsula, Sumatra, Borneo ..... *padda*
- Lateral pronotal fasciae running from eyes to lateral fasciae on mesonotum (fig. 6). Malayan Peninsula, Sumatra, Borneo ..... *duarum*
8. Underside of postclypeus with median, triangular, black mark at the clypeal suture .....9
- Underside of postclypeus without such a mark. Malayan Peninsula ..... *saudarapadda*
9. Male operculum with distinct transverse fascia (fig. 38). Borneo ..... *agatha*
- Male operculum without distinct transverse fascia. Sumatra ..... *moultoni*
10. Pronotum with a pair of (sometimes narrow) brown to black lines or marks behind the eyes at innersides of lateral parts of ambient fissure (fig. 37) .....11
- Pronotum without such lines or marks.....20
11. Lateral fasciae on mesonotum about as wide as, or broader than, distance between lateral and paramedian fasciae (fig. 37).....12
- Lateral fasciae on mesonotum much narrower than distance between lateral and paramedian fasciae (fig. 27) .....13
12. Male operculum with distinct transverse fascia (fig. 38). Borneo ..... *agatha*
- Male operculum without distinct transverse fascia. Sumatra ..... *moultoni*
13. Male operculum with distinct brownish transverse fascia just below constriction of operculum, and without white area along apical margin. Body length male: 35-42 mm.....14
- Male operculum without distinct brownish transverse fascia, but with very narrow to broad, white, area along apical margin. Body length male: 27.5-35.5 mm .....15
14. Male uncus as in figs. 29-31. Borneo.. *montivaga*
- Male uncus as in figs. 33, 35-36. Malayan Peninsula, Sumatra..... *ruslani*
15. Tegmina without infuscations at the bases of the 5th and 7th apical areas, or at the apices of the longitudinal veins .....16
- Tegmina with well to weakly developed infuscations at the bases of the 5th and 7th apical areas and at the apices of the longitudinal veins .....18
16. Median and paramedian fasciae on the mesonotum more or less fused (fig. 119). Lateral lobes of male pygofer apically rounded (fig. 122). Sulu Archipelago: Basilan ..... *confluens*
- Median and paramedian fasciae on the mesonotum separate. Lateral lobes of male pygofer weakly pointed to nipple-shaped and upcurved (figs. 132, 133, 137). .....17
17. Apical spine of the male uncus very broad (fig. 136). Philippines: Lubang..... *latispina*
- Apical spine of the male uncus narrow (fig. 133). Philippines..... *fuliginosa*
18. Median mesonotal fascia widening distad to 6× its anterior width or more (fig. 115). Lateral lobes of male pygofer apically rounded, without protrusion (fig. 118). Philippines: Mindanao..... *inermis*
- Median mesonotal fascia widening distad to 2-3× its anterior width. Lateral lobes of male pygofer apically with distinct upcurved nipple-shaped protrusions (figs. 141, 145) .....19
19. Male abdomen dorsally yellowish with a greenish tinge; anterior margin of segment 4 with dark brown, medially weakly bicuspidate and laterally strongly widened marking (fig. 111). Malayan Peninsula, Borneo ..... *alticola*
- Male abdomen dorsally brown to dark brown; anterior margin of segment 4 without distinct marking (fig. 138). Palawan, Balabac, Busuanga ..... *noonadani*
20. Lateral fasciae on mesonotum strongly outcurved

- (fig. 107). Timbal covering black-brown in laterobasal corner; dark coloration covering one third to half of timbal surface (fig. 107). Colour of male opercula light brown in basal one third and gradually turning to brownish black in distal two thirds. Borneo ..... *kinabaluana*
- Lateral fasciae on mesonotum straight or weakly outcurved. Timbal covering unicolorous brownish or greenish. Colour of male opercula black to black brown along medial margin and in apical part; this black to black-brown coloration contrasts strongly with the brownish to ochraceous colour of the rest of the operculum ..... 21
  - 21. Tegmina with large infuscations at basal veins of 2nd, 3rd, 5th and 7th apical areas, and with small but distinct infuscations at apices of longitudinal veins of apical areas 2-6; apex of cubital vein CuA1 with large infuscation which may be connected with infuscation at basal vein of 7th apical area. Mesonotal marking as in fig. 77. Borneo ..... *hollowayi*
    - Tegmina with distinct infuscations at basal veins of 2nd and 3rd apical areas, and often with small infuscations at basal veins of 5th and 7th apical areas and at apices of longitudinal veins of apical areas 2-7. Mesonotal marking different ..... 22
    - 22. Pronotum with narrow, dark brown to black fasciae in and along posterior oblique fissures (fig. 72). Male abdominal segments 3-4 with a pair of very conspicuous, rectangular, paramedian black marks (fig. 72). Borneo ..... *maculosa*
      - Pronotum without dark brown to black fasciae in and along posterior oblique fissures. Male abdominal segments 3-4 with less distinct transverse brownish marks or with different marking. .... 23
      - 23. Apical two thirds of male operculum narrow (fig. 65). Medial margin weakly convex. Lateral margin very slightly convex in basal third, very weakly concave at one third or one fourth of its length from base, and straight along apical two thirds up to rounded apex. Body length male 30.5-35 (32.6±1.1) mm. Borneo ..... *angustata*
        - Apical two thirds of male operculum fairly broad (figs. 66, 67). Medial margin fairly strongly convex. Lateral margin convex in basal third, distinctly concave at one third or one fourth of its length from base, and fairly strongly convex to broadly rounded apex ..... 24
        - 24. Anterior part of lateral fasciae on mesonotum one sixth to one third as wide as distance between paramedian and lateral fasciae (fig. 69). Body length male: 28.9-33.5 (31.4±1.3) mm. Borneo. .... *phaeophila*
          - Anterior part of lateral fasciae on mesonotum one third as wide to as wide as distance between para-
    - median and lateral fasciae (fig. 57). Body length male: 27.7-30.6 (29.1±1.0) mm. Malayan Peninsula, Sumatra ..... *guttigera*
    - 25. Male operculum with broad, transverse, brown fascia at about half-length; area between fascia and brown apical margin of operculum yellow (fig. 86, 89). Male pygofer as in fig. 83. Palawan ..... *palawana*
      - Male operculum without transverse fascia ..... 26
      - 26. Body colour vividly green, male abdomen with distinct black and brown marking and a pair of conspicuous lateral white waxy marks on segment 3 (fig. 98). Black-brown marking along medial and apical margins of male operculum covering more than apical one fourth of operculum (fig. 91). Male pygofer as in fig. 96. Malayan Peninsula, Sumatra, Borneo ..... *vanbreei*
        - Body colour brown; male abdomen brownish without distinct marking and without waxy marks. Black brown marking along medial and apical margins of male operculum covering less than apical one fifth of operculum ..... 27
        - 27. Male pygofer as in fig. 95. Sumatra ..... *sumatrana*
          - Male pygofer as in fig. 82. Malayan Peninsula, Borneo ..... *ida*

### *Orientopsaltria padda* group

#### Diagnosis

The *padda* group consists of four fairly large-sized species (body length male: 33-39 mm): *O. duarum*, the type species of the genus, *O. padda*, *O. saudarapadda*, and *O. moultoni*. *O. duarum* and *O. padda* are found in the Malayan Peninsula, Sumatra and Borneo, *O. saudarapadda* and *O. moultoni* are presumably endemic to the Malayan Peninsula and Sumatra respectively. The *padda* group is characterized by very broad lateral mesonotal fasciae reaching to the anterior margin of the mesonotum; these characters are also found in *O. agatha* of the *montivaga* group, while *O. brooksi* has narrow lateral fasciae reaching to the anterior mesonotal margin. The tegmina of the species of the *padda* group are infuscated at the bases of the 2nd and 3rd and sometimes 5th apical areas and at the apices of the longitudinal veins. The male genitalia of *O. padda*, *O. saudarapadda* and *O. moultoni* are fairly similar, sharing a stout and more or less straight lateral spine of the uncus, and a short, hook-shaped medial spine; in *O. duarum* the shape of the uncus is quite different.

#### *Orientopsaltria duarum* (Walker, 1857)

(figs. 6-9, 18, plate 1: 1)

*Dundubia duarum* Walker, 1857: 141. Holotype ♂: 'SAR', 'Wallace', 'duarum' and 'Type' (round label; green circle)

(in BMNH) [examined].

*Dundubia duarum*; Dohrn 1859: 73; Stål 1862a: 478; Stål 1862b: 590; Stål 1863: 98; Distant 1890: 49; Distant 1892b: 153; Moulton 1911a: 123.

*Cosmopsaltria duarum*; Distant 1906: 55; Moulton 1911a: 137, 138; Moulton 1911b: 186, 188, 190; Distant 1912: 44; Distant 1913: 41; Kirkaldy 1913: 9; Distant 1917: 322; Moulton 1923: 88, 92, 126, 167; Moulton 1925: 434; Moulton & China 1926: 121, fig c (this figure shows the uncus of *duarum* and not of *padda*; the figures of the uncus of the two species were shifted; Moulton & China 1927 mention this error); Moulton & China 1927: 124.

*Orientopsaltria duarum*; Kato 1944a: 7; Kato 1944b: 10; Metcalf 1963: 557, 558; Duffels 1968: 79, 81, 83; Duffels 1983: 3, 10; Duffels & Van der Laan 1985: 119; Zaidi & Ruslan 1995b: 198, 200; Zaidi & Ruslan 1995c: 217-219, 222; Zaidi et al. 1996: 60; Duffels & Zaidi 1998: 320, 321.

*Cosmopsaltria lauta* Distant, 1888: 293. Holotype ♂: 'Pontianak. 8.86 / Bollen', 'M. R. Belg.', 'Cosmopsaltria / monticola', 'Cosmopsaltria / lauta Dist. (type)', 'Type' (KBIN) [examined].

*Cosmopsaltria lauta*; Distant 1889a: 421; Distant 1889b: 48; Distant 1890: 49, pl.5, figs. 8, a, b; Distant 1892b: xii; Breddin 1900: 176; Distant 1906: 55 (in syn. of *C.*

*duarum*); Moulton 1911a: 137, 138 (in syn. of *C. duarum*); Moulton 1911b: 186 (in syn. of *C. duarum*); Distant 1912: 44 (in syn. of *C. duarum*); Moulton 1923: 92 (in syn. of *C. duarum*); Metcalf 1963: 557 (in syn. of *C. duarum*).

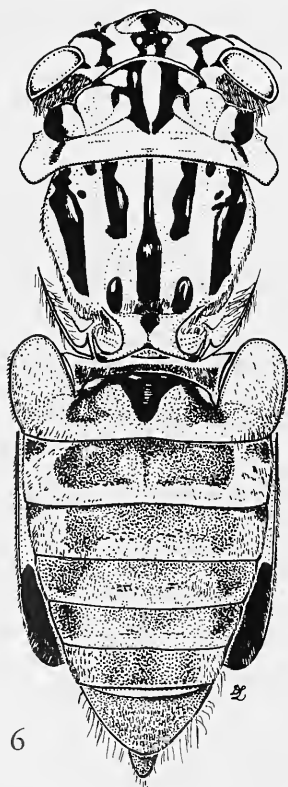
[Misidentifications

*Cosmopsaltria duarum* var. *laticincta* Walker; Lallemand 1931: 74 (the specimen from Borneo, Samarinda belongs to *O. angustata*; the specimen from Sumatra belongs to *O. moultoni*)

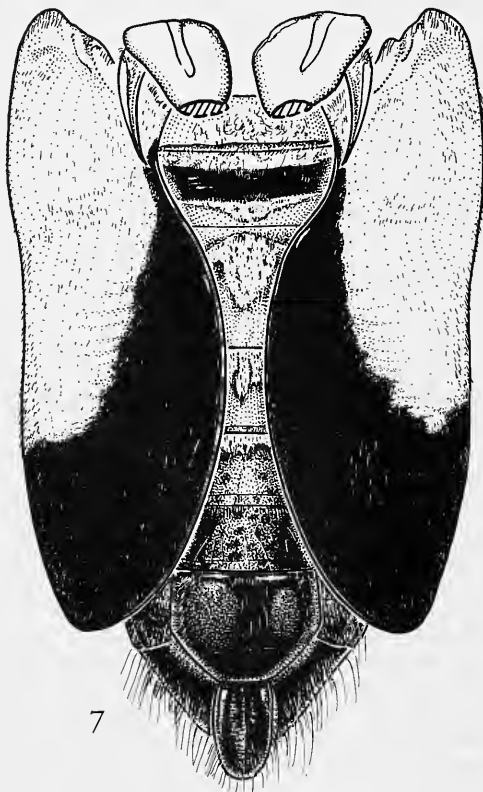
*Cosmopsaltria duarum*; Kato 1932: 165, pl. 26 fig. 2 (the specimen from Borneo depicted here belongs to *O. padda*); Lallemand 1931: 74 (the specimen from Borneo, Balikpapan belongs to *O. padda*, the specimen from Samarinda to *O. saudarapadda*; the specimen from Sumatra, Bireun, belongs to *O. ruslani*).

*O. duarum* has a restricted distribution in the western part of Borneo, along the east coast of Sumatra and in the southwestern part of Malayan peninsula (fig. 9). Though one specimen is labelled 'Java', its occurrence on this island is improbable.

*O. duarum* resembles *padda* though both species can be easily separated by the position of the lateral



6



7

Figs. 6, 7. *Orientopsaltria duarum*, male. – 6, body in dorsal view, Sumatra, Sennah Estate Negerilama; 7, abdomen with opercula in ventral view, Sumatra, Dumai.

fascia on the pronotum, situated laterally in *padda* and on a line with the lateral mesonotal fascia in *duarum*; the species also differ in the marking on the male abdomen. The male uncus of *duarum* is unique in shape, so that the males cannot be confused with any other *Orientopsaltria* species.

When Distant wrote 'A monograph of Oriental Cicadidae' he could not find Walker's type of *duarum* in the collection of the BMNH (see Distant 1890: 49, footnote, Distant 1892b: 153). Distant therefore regarded *D. duarum* as an unrecognisable species. Some years later, after the type of *duarum* was recovered, *C. lauta* was synonymised with *duarum* (Distant 1906; 1912).

### Description of male

Ground colour brown to ochraceous, sometimes with greenish tinge.

Head. — Head from dorsal aspect with large, black, median mark, that encloses the ocelli, slightly narrows distad to frontoclypeal suture and continues on postclypeus in a median, round, lanceolate or mushroom-shaped, brown mark extending to median oval spot on anterior part of postclypeus, and dividing proximad in two short fasciae reaching posterior margin of head and enclosing a median ground coloured spot. A pair of fairly broad, irregular fasciae run parallel to inner curve of eyes from vertex lobe to posterior margin of head, at a distance to eye equal to the fascia width. Supra-antennal plates dorsally with small, black mark, that continues on underside of head in a broad, straight, dark brown, oblique fascia running from antenna to eye. Anterior part of postclypeus with 3-5 brownish to black-brown transverse lines on either side; median ends of these lines connected by a line enclosing an oval spot of the ground colour. Lower part of postclypeus and anteclypeus sometimes with two very narrow parallel lines. Rostrum brown to dark brown apically; extending beyond hind coxae.

Thorax. — Fasciae on thorax black-brown to black. Pronotum. Paired central fasciae slightly widened anteriorly and sometimes continuing laterad in a very narrow black line along very light-coloured rim at anterior margin of pronotum; posterior ends of fasciae fused or almost fused at anterior margin of pronotal collar; central fasciae narrowest at half-length, though this part seems to be fairly broad due to a pair of brown to black stripes above proximal parts of anterior oblique fissures. A pair of lateral fasciae, each running from a dark mark at innerside of lateral part of ambient fissure across pronotal collar to lateral fascia on mesonotum.

Mesonotum. — Five fairly broad, black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation, and ending in a black triangle on cruciform elevation, posterior half 2-2.5× as

wide as anterior part. Paramedian fasciae extending from anterior margin to just beyond half-length the mesonotum, 1.5-2× as wide as anterior part of median fascia and about as broad as distance between paramedian and median fasciae. A pair of round black spots in front of anterior angles of cruciform elevation. Lateral fasciae continuous from anterior to posterior margin of mesonotum and about as broad as distance between lateral and paramedian fasciae. A pair of small black triangles at anterior mesonotal margin between paramedian and lateral fasciae.

Legs. — Fore femora with subapical dark marks on inner and outer sides and with light brown streaks on inner and upper sides; underside with dark line connecting spines; innersides of hind femora with broad brown fascia extending along whole length of femur. Distal half to two thirds of fore tibiae and distal one thirds of middle and hind tibiae dark brown to black-brown; hind tibiae with proximal dark mark. Tarsi of

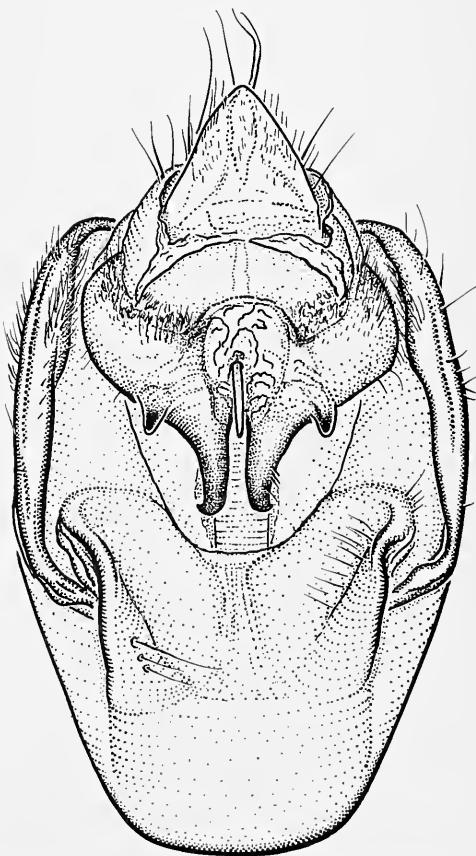


Fig. 8. *Orientopsaltria duarum*, male pygofer in ventral view, Sumatra, Sennah Estate Negerilama.

fore and middle legs dark brown to black-brown.

**Tegmina and wings.** – Tegmina with basal veins of 2nd and 3rd apical areas infuscated, and often with small faint spots at apices of longitudinal veins. Tegmina suffused with very light brown, especially in the apical part. Venation of tegmina light brownish in basal third, turning dark brown more apically. Venation of wings brownish.

**Operculum** (figs. 7, 18). – Elongate and broad, reaching to half-length abdominal segment 7. Medial margin evenly convex. Lateral margin convex in basal part, strongly concavely sinuate at one third to one fourth of its length from base, and very weakly convex in apical two thirds. Apical part of operculum broadly rounded. Operculum variable in shape, especially in width, mainly due to the variable convexity of the apical two thirds of medial margin. Operculum black to black-brown along medial margin: this coloured border is very narrow at base of medial margin, and attains one third of operculum width at half-length of operculum; apical one fourth to one third of operculum black to black-brown across its whole width, with exception of a narrow area along lateral margin.

**Abdomen.** – Dorsally, brownish with medial, dark brown, obconical spot at anterior margin of segment 2 reaching to three fourths of segment length, and narrowly connected with pair of paramedian, trans-

verse marks. Anterior two thirds of segments 3 and 4, with exception of the lateral parts, dark brown. Segments 3-5 sometimes with narrow, lanceolate, median spots. Segments 6-8 somewhat darker than other segments, especially along anterior margin. Ventral side of abdomen brown to black-brown.

**Genitalia** (fig. 8). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with thick outcurved ridges. Uncus with large and globose basal part. Uncus lobes broad at base, and strongly narrowing to incurved apices; lateral margins of uncus lobes basally weakly convex, more or less distinctly concave toward apex, and with distinct, curved, short and strong spine at half-length. Arcuate ridge over narrow gap between uncus lobes fairly strongly elevated and outcurved.

**Measurements** ( $n = 5\delta$ ). – Body length 34.5-35.5 mm; head width 11.8-12.4 mm; pronotum width 12.3-13.0 mm; tegmen length 46.5-49 mm.

**Material examined.** – 52 $\delta$ . MALAYSIA: PENINSULAR MALAYSIA: PERAK: Telok Anson, Hussin Rani, 1 $\delta$  (UKM); SELANGOR: Klang, Blackwater Est., 30.v.1916, ex coll. Agr. Dept., B.M.1955-354, 1 $\delta$  (BMNH); Blackwater Estate, x.1916, F.M.S. Agric. Dept. Kuala Lumpur, 1 $\delta$  (MNKM); Blackwater Estate, Klang, 30.v.1916, F.M.S. Agric. Dept. Kuala Lumpur, 1 $\delta$  (MNKM); Kuala Selangor, 15.i.1994,

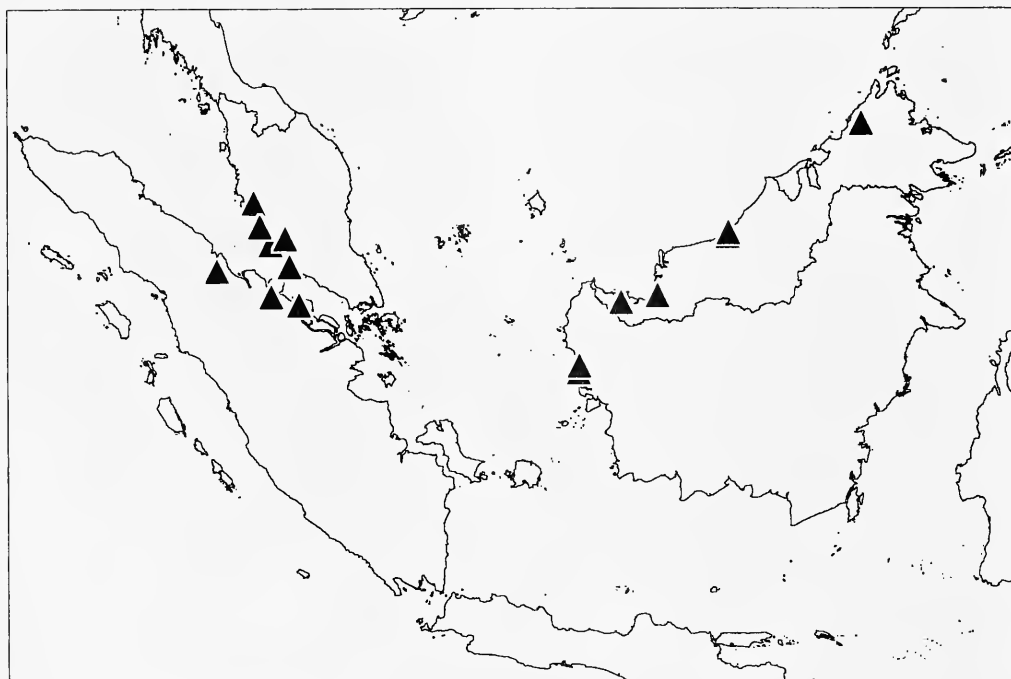


Fig. 9. Distribution of *Orientopsaltria duarum*.

Mahadir, 1♂ (UKM); Kuala Selangor, 15.i.1979, 1♂ (UKM); Pasir, Panjang, Bt. 11, 11.xi.1991, 8♂ (UKM); Parit Sebelas, Sg. Besar, 25.iv.1993, 1♂ (UKM); Tanjung Karang, 13.x.1990, 1♂ (UKM); NEGERI SEMBILAN, Cape Rachado, Light House, x.1920, J.B. Gostelow, 1♂ (MNKM); OTHER LOCALITIES: Malay Peninsula, ex F.M.S. Museum, B.M.1955-354, 6♂ (BMNH); Presqu'île de Malacca, Errington de la Croix et P. Chapé, 1899, 1♂ (MNP); SABAH: Gunung Kinabalu, Sayap, 3-8.vi.1992, Zaidi, Ismail, Ruslan, 1♂ (UKM). – SARAWAK: Bau, xi.1901, 1♂ (MSK); Bintulu, 14.viii.1994, Zaidi & Tahib, 1♂ (UKM); Kedurong, 1910, J.C. Moulton, 1911-141, 1♂ (BMNH); Kedurong light-house, i.1911, 1♂ (MSK); Kuching, 3.iii.1900, 1♂ (MSK); Kuching, Matang Road, 6.ix.1910, 1♂ (MSK); Sadong, 1♂ (MSK); Sarawak, Saribas, ix.1922, 1♂, same data but x.1923, 1♂, xi.1923, 1♂ (MNKM). – INDONESIA: KALIMANTAN: Riv. Mandor, 1898, R. Oberthür, 1♂ (MNP); Pontianak, Andre, 1♂ (BMNH); Pontianak, 1898, R. Oberthür, 1♂ (MNP); Pontianak, F. Muir, 1♂ (BPBM); Pontianak, Borneo Exp. Max Weber, 1♂ (RMNH); Pontianak, 31.vii.1923, J.A. Juriaanse Tarvena, 1♂ (RMNH). – SUMATRA: Bengkalis, Maindron, 1885, 6912 89, 1♂ (MNP) 1♂ (ZMA); Dumai, 30.i.1984, J. Matijssen, 1♂ (ZMA); EC Sumatra, Sennah Estate, Negerilama, ix.1954, A. Sollaart, lowland cultivated area, on light, 1♂, same data but vii.1954, 1♂ (RMNH); EC Sumatra, Negerilama, ix.1954, A. Sollaart, lowland cultivated area, on light, 1♂ (RMNH). – JAVA: Java, v. Lansberg, 1♂ (RMNH).

***Orientopsaltria padda* (Distant, 1887)**  
(figs. 10-13, 19, 42, plate 1: 2)

*Cosmopsaltria padda* Distant, 1887: 229. Holotype ♂: 'Penang (Biggs)', 'padda Dist.', 'Type' (round label; red circle) (BMNH) [examined].  
*Cosmopsaltria padda*; Distant 1889b: 48 (in syn. of *Cosmopsaltria latilinea*); Distant 1906: 55 (in syn. of *Cosmopsaltria duarum* var. *latilinea*); Moulton 1911a: 138 (in syn. of *Cosmopsaltria latilinea*); Moulton 1911b: 186 (in syn. of *Cosmopsaltria latilinea*); Moulton 1923: 88, 92, 96, 167; Moulton & China 1926: 121, fig b (this figure shows the uncus of *padda* and not of *duarum*; the figures of the uncus of the two species were shifted; Moulton & China 1927 mention this error); Moulton & China 1927: 124; Kato 1932: 165; Mercalf 1963: 553.  
*Cosmopsaltria latilinea* (nec Walker); Distant 1889b: pl. 4 figs. 15, a, b.  
*Cosmopsaltria duarum* var. *vera* Moulton, 1911b: 187; Moulton 1923: 92 (in syn. of *C. padda*).  
*Cosmopsaltria duarum* var. *padda*; Distant 1912: 44; Moulton 1923: 92 (in syn. of *C. padda*).  
*Orientopsaltria padda*; Duffels 1983: 10; Zaidi & Ruslan 1995a: 65, 68; Zaidi & Ruslan 1995b: 198, 200; Zaidi & Ruslan 1995c: 217-219, 222; Zaidi 1996: 97, 98, 100, 101, 104; Zaidi & Hamid 1996: 49, 50, 53, 56, 57; Zaidi et al. 1996: 61; Zaidi 1997: 109, 112, 113; Duffels & Zaidi 1998: 319, 321, 330, 331.

*O. padda* has a wide distribution in Borneo (Sabah, Sarawak and Kalimantan), Sumatra and Peninsular Malaysia (fig. 12), while three specimens from Thailand are provisionally identified as *O. padda*. The locality 'China' of two specimens is doubtful.

*O. padda* can be separated from the other species of the genus by the broad lateral pronotal fasciae running from the eye, along innerside of lateral part of ambient fissure, across the pronotal collar to the base of the tegmen (fig. 10). Lateral pronotal fasciae are also found in *O. duarum*, but the fasciae in this species are on line with the lateral fasciae of the mesonotum (fig. 6). The two species have very different uncus lobes, and also differ in the marking on the male abdomen, but this marking is not always very distinct.

*O. padda* is closely related to *O. saudarapadda*, which is probably endemic to Peninsular Malaysia. The latter differs from *O. padda* in a somewhat larger body size, absence of lateral pronotal fasciae (fig. 15), coloration of the male operculum (fig. 16), and shape of the male uncus (fig. 14). *O. padda* also resembles *O. moultoni* China, an endemic of Sumatra. The latter species can be separated from *padda* by the absence of lateral pronotal fasciae continuing on the pronotal collar, slightly outcurved lateral mesonotal fasciae, the presence of a median black line widening toward the clypeal suture on the underside of postclypeus, and the shape of the basal pygofer lobes.

**Identity and synonymy**

*Orientopsaltria padda* was described by Distant (1887) after one male from Penang. Two years later, Distant (1889b) synonymized *Cosmopsaltria padda* with *Cosmopsaltria latilinea* (Walker, 1867), but later (Distant 1906) he considered *latilinea* a variety of *Cosmopsaltria duarum* Walker, and *padda* a synonym of this variety. In 1912, Distant listed both, *latilinea* and *padda*, as varieties of *duarum*. Moulton (1911a, b) initially followed Distant (1889b) and treated *padda* as a synonym of *latilinea*. Some years later, after examination of the male genitalia of the species concerned, Moulton (1923) came to the conclusion that *padda* and *duarum* are different species that can easily be distinguished by the different structure of the male uncus and the position of the lateral fasciae on the pronotum. In the same paper, *Cosmopsaltria duarum* var. *vera*, described by Moulton in 1911, was synonymized with *padda*. With regard to *Cosmopsaltria latilinea*, Moulton (1923) stated that this species has nothing to do with the genus *Cosmopsaltria*, and is referable to the genus *Maua* Distant, 1905.

Comparison of the holotype of *Cosmopsaltria padda* and a specimen of *duarum* var. *vera* from Kedurong, Sarawak, that was compared by Moulton with the type of *vera*, confirmed the correctness of the synonymy established by Moulton in 1923.

*O. padda* is depicted in Distant's monograph (Distant 1889b: pl. 4 figs. 15, a, b) under the name *Cosmopsaltria latilinea*. *O. padda* can easily be distinguished from the other Bornean species of the genus

on account of the marking on the pronotum and the structure of the male genitalia.

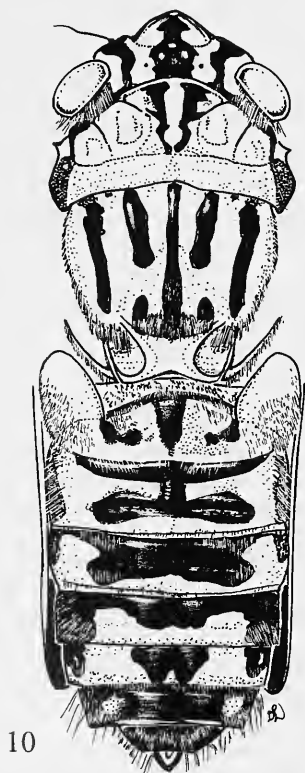
### Description

Ground colour brown to ochraceous, sometimes with greenish tinge.

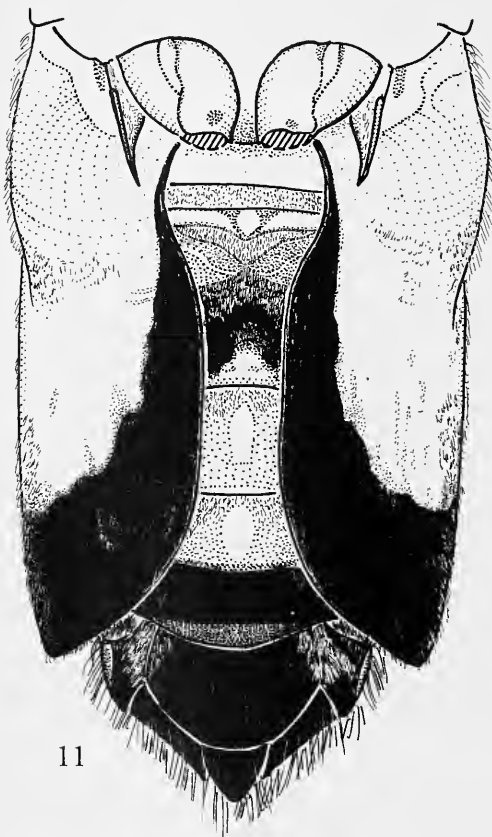
Head. — Head from dorsal aspect with large, black, median mark, that encloses the ocelli, slightly narrows distad to frontoclypeal suture and continues on postclypeus in a median, round, lanceolate or mushroom-shaped, black mark extending to median oval spot on anterior part of postclypeus, and dividing proximad in two short fasciae reaching posterior margin of head and enclosing a median ground coloured spot. A pair of irregular short fasciae run parallel to inner curve of eyes from vertex lobe to posterior margin of head, at a distance to eye equal to the fascia width. Black coloration on anterior half of supra-antennal plates continues on underside of head as a

broad, straight, and black, oblique fascia running from antenna to eye. Anterior part of postclypeus with 3-5 black-brown to black transverse lines on either side; median ends of these lines connected by a line enclosing an oval spot of the ground colour. Remaining parts of postclypeus and anteclypeus unmarked. The specimens from peninsular Malaysia have a darker marking on the head than those from Borneo. Rostrum brown to dark brown apically; extending beyond hind coxae.

Thorax. — Fasciae on thorax black. Pronotum. Paired central fasciae slightly widened anteriorly in specimens from Borneo, but strongly widened to anterior oblique fissures in most specimens from Sumatra and Peninsular Malaysia, and sometimes even continuing more laterad in a very narrow black line; posterior ends of central fasciae fairly narrow, converging, and fused or almost fused at anterior margin of pronotal collar. The lateral pronotal fasciae run



10



11

Figs. 10, 11. *Orientopsaltria paddy*, male. — 10, body in dorsal view, Sabah, Danum Valley Field Centre, 70 km W Lahad Datu; 11, abdomen with opercula in ventral view, Sabah, 60 km W of Lahad Datu, Danum Valley Field Centre, at junction Sg Segama and Sg Palum Tambun.

from eye along innerside of lateral part of ambient fissure across pronotal collar to base of tegmen.

**Mesonotum.** – Five fairly broad fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation, and ending in a black triangle on cruciform elevation, posterior half 1.5–3× as wide as anterior part. Paramedian fasciae extending to just beyond half-length of mesonotum, 1.5–5× as wide as anterior part of median fascia, and about as broad as or somewhat broader than distance between paramedian and median fasciae. A pair of round black spots in front of anterior angles of cruciform elevation. Lateral fasciae continuous from anterior to posterior margin of mesonotum and about as broad as distance between lateral and paramedian fasciae. A pair of small black triangles at anterior mesonotal margin between paramedian and lateral fasciae.

Legs as in *duarum*.

Tegmina and wings as in *duarum*.

### Male

**Operculum** (figs. 11, 19). – Elongate and broad, reaching to distal part of abdominal segment 6 or half-length segment 7. Medial margin sometimes evenly convex, but in many specimens straight at about half-length. Lateral margin convex in basal part, strongly concavely sinuate at one third to one fourth of its length from base, and weakly convex in apical two thirds. Coloration of operculum as in *duarum*.

**Abdomen.** – Abdomen dorsally either light brown to ochraceous with a more or less distinct marking or darker brown with very indistinct marking. Distinct marking consisting of a median, triangular to obconical mark at anterior margin of segment 2, reaching to half or three fourths of segment length, and a similar somewhat smaller spot on segment 3; segments 2–4 with pair of paramedian transverse marks situated at half the segment's height, those on segment 2 are small and very narrow, whilst those on segments 3–4 are one fourth as wide as the segment, variable in height, and sometimes reach anterior and/or posterior segment margins; segments 5–6 laterally dark-coloured, and with black transverse median marks, about one fourth to one third as wide as segment and reaching from anterior margin distad, sometimes reaching posterior segment margin; segments 7–8 mainly dark-coloured. Ventral surface of abdomen brown to black-brown.

**Genitalia.** – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with thick outcurved ridges. Uncus with large and globose basal part. Uncus lobes with straight, broad, and usually very stout lateral spine attenuating to apex, which is longer than the hook-shaped medial spine; lateral margins of uncus lobes straight and slightly conver-

gent. Arcuate ridge over narrow gap between uncus lobes fairly strongly elevated and laterally outcurved.

### Female

**Operculum** (fig. 42). – Pale ochraceous, reaching to just beyond posterior margin of abdominal segment 2. Lateral margin undulate; laterodistal corner of operculum rectangular. Posterior margin straight and parallel to margin of abdominal segment 3, but medially distinctly convexly curved toward meracanthus.

Abdomen brown, with exception of the ochraceous posterior one third or half of tergites 2–6, a pair of fairly large, paramedian, black-brown spots on sternite 7, and a dark coloration around the medial incision of the posterior margin of that sternite.

**Measurements** (n=6♂ 1♀). – Body length ♂ 35–39 mm, ♀ 32 mm; head width ♂ 11.3–12.3 mm, ♀ 11.5 mm; pronotum width ♂ 12.1–13.5 mm, ♀ 12.5 mm; tegmen length ♂ 48–52.5 mm, ♀ 47.5 mm.

### Variability

Most specimens from the Malayan Peninsula and Sumatra differ from Borneo specimens by broader markings on the head, anteriorly strongly widened central pronotal fasciae, somewhat broader fasciae on the mesonotum, and a much stouter lateral spine of the uncus lobe. However, some specimens from the peninsula and Sumatra have a fairly narrow marking on head and thorax, while others have a somewhat narrower lateral uncus spine.

One male specimen with the labels: Borneo, Doesonlanden, (Wahnes), *Cosmopsaltria lauta* (BMNH), has a light-coloured abdomen with dark marking. Its genitalia are like those of *O. padda*, but the big lateral spine of the uncus is narrower than in that species.

Three specimens from southeastern Thailand have a distinctly more slender body than the specimens of *O. padda* described above: body length 36.5–39 mm; head width 10.6–11.3 mm; pronotum width 11.3–11.7 mm; tegmen length 44.5–45.5 mm. The lateral pronotal fasciae running from eye to base of tegmen which characterize *padda*, are missing in these specimens. They have only a small black mark behind the eye at the inner margin of the ambient fissure. Furthermore the opercula of these specimens reach to half-length or two thirds of abdominal segment 6, and have dark brown medial margins and apical parts. The lateral spines of the uncus lobes are more slender, straight, and more or less parallel. The specimens have been identified provisionally as *Orientopsaltria* cf *padda*, awaiting new material from this area coming available.

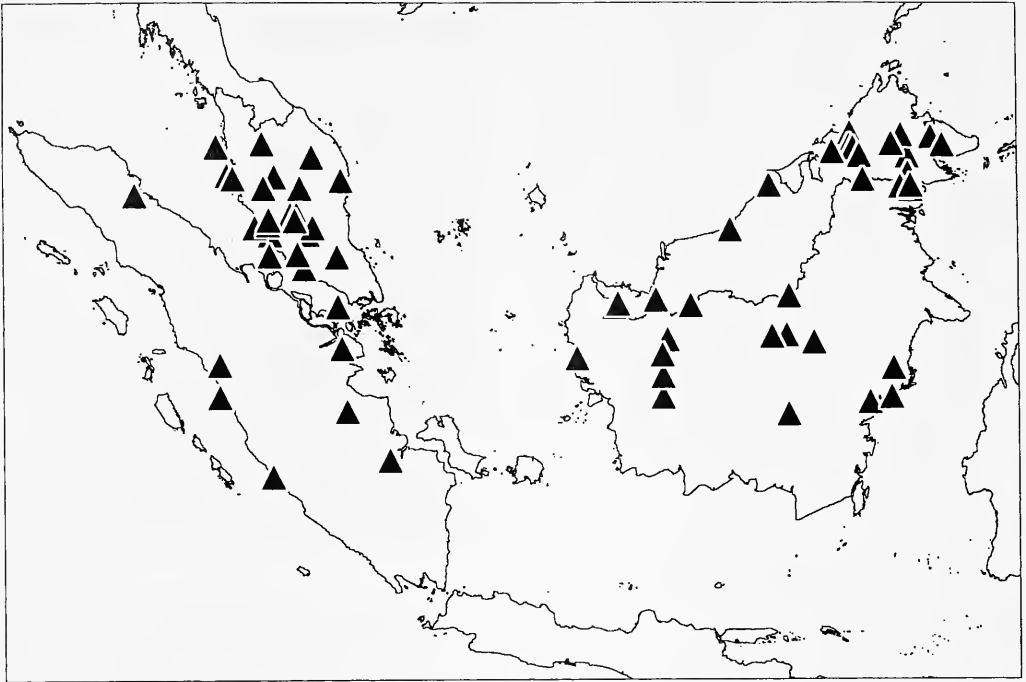


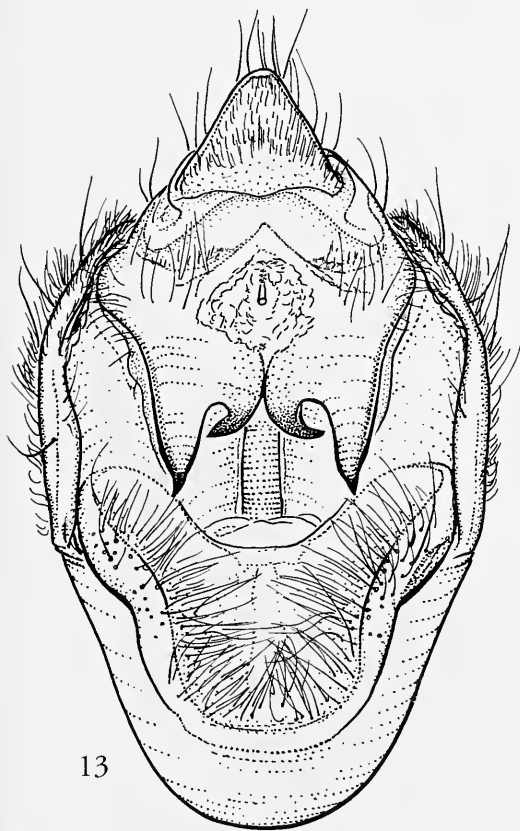
Fig. 12. Distribution of *Orientopsaltria padda*.

Material examined. – 243 ♂ 1 ♀. MALAYSIA: PENINSULAR MALAYSIA: KELANTAN: Gua Musang, Mendrop, 2.ii.92, Zaidi, Ruslan & Ismail, 1 ♂, same data but 5.ii.92, 1 ♂ (UKM); TERANGGANU, Tasik Kenyir, 29-30.iii.93, Zaidi, Ruslan, Kudin, 1 ♂ (UKM); PERAK: Banding 29-30.vi.91, Ismail, Yusof, Zabidi, 7 ♂ (UKM); Banding, 2.xi.1991, Ismail, Ruslan, J'dln, 1 ♂ (MNKM); Kuala Kangsar, Grubauer, 1902, 1 ♂ (NHMW); Maxwell Hill, 1350 m, 17-20.iii.1958, T. C. Maa collector BISHOP, 2 ♂ (BPBM); Perak, Reg. de Zekka, L. Girauld, 1916, 1 ♂ (MNP); Taiping, 26.iv.1935, H.M. Pendlebury F.M.S. Museum, Ex F.M.S. Museum, B.M. 1955-354, 1 ♂ (BMNH); Taiping, vi.1977, K.C. Liew, 1 ♂ (Moulds); Taiping, 26.iv.1938, Ex F.M.S. Museum, B.M. 1955-354, 1 ♂ (BMNH); PAHANG: Cameron Highlands, T. Rata, 4700 ft, 18.v.1939, light, H.M. Pendlebury, coll. F.M.S. Museums, Ex F.M.S. Museum, B.M. 1955-354, 1 ♂ (BMNH); B. Fraser, 3.v.91, Zaidi, Ismail, Ruslan, 1 ♂ (UKM); Fraser's Hill, 1300 m, 16.iii.66, J. & M. Sedlacek, M.V. Light Trap, 1 ♂ (BPBM); Fraser Hill, 1.iii.1930, A.S. Corbet, A.S. Corbet coll., B.M. 1948-587, 1 ♂ (BMNH); Fraser's Hill, 9.ii.1932, Prince Léopold, R. Mus. Hist. Nat. Belg. I. G. 9796, *Cosmopsaltria duarum* Walk., V. Lallemand det., 1934, 2 ♂ (KBIN); Fraser's Hill, 4000 ft, 31.i.1929, H.M. Pendlebury, F.M.S. Museums, ex F.M.S. Museum, B.M. 1955-354, 3 ♂ (BMNH); Gap, 17.ii.1929, A.S. Corbet, A.S. Corbet coll., B.M. 1948-587, 1 ♂ (BMNH); The Gap, iii.1921, ex coll. Agr.Dept., 3 ♂ (BMNH); Jerantut, 100 m, 9.x.1982, P.J.H. v. Bree, 2 ♂ (ZMA); Kuala Lompat, 25-27.viii.90, Ismail & Zabidi, 2 ♂ (UKM); Kuala Lompat, 27.viii.1992, Ruslan, 3 ♂ (UKM); Kuala Lompat, 2-6.ii.92, Dali & Ripin, 2 ♂ (UKM); Kuala Lompat, 30.1-1.ii.93, Eliz-

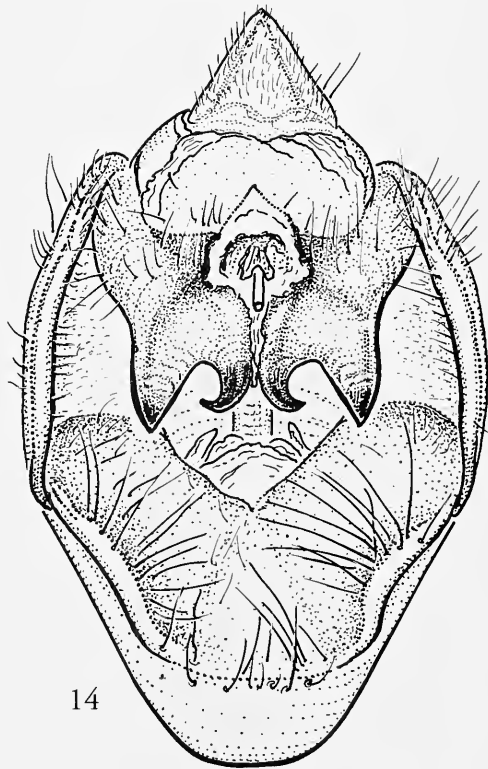
abeth Lee, 1 ♂ (UKM); Merapoh, 5.ii.92, Zaidi, Ismail, Ruslan, 4 ♂ (UKM); Rompin Mining Co., Railway Track, Petoh, T. C. Maa collector BISHOP, 1 ♂ (BPBM); Kuala Tahan, 15-16.xii.1958, L.W. Quate collector, 2 ♂ (BPBM); Kuantan, Bukit Garing, 19.i.83, Rabbiah Bakar, 1 ♂ (UKM); Taman Negara, Kuala Tahan, 4.iii.1995, Heiss & Perner, 1 ♂ (ZMA); Tasik Chini, Kg. Melayu, 14.iv.1993, Zaidi, Ruslan, Kudin, 1 ♂, same data but 15.iv.1993, 1 ♂ (UKM); Taman Negara, Lata Berkoh, 30.ix.1995, Zaidi, Ruslan, M'dir, 1 ♂ (UKM); Taman Negara, Kuala Juram, 16-19.x.1995, Ruslan, 2 ♂ (UKM); T. Negara, Kuala Kenyam, 29-31.viii.1995, Zaidi, Ruslan & M'dir, 20 ♂, (UKM); T. Negara, 28-29.vii.1995, Zaidi & Ruslan, 1 ♂ (UKM); Bukit Rengit, 24-27.i.1992, Effendy, 1 ♂ (UKM); SELANGOR: Bangi, Univ. Kebangsaan, 13-14.viii.1994, Ruslan, 1 ♂, same data but: 20-21.viii.1994, 1 ♂ (UKM); Bukit Kutu, 3500 ft, 17.iii.1931, at light, H. M. Pendlebury, Ex F.M.S. Museum, B.M. 1955-354, 1 ♂ (BMNH); Bukit Kutu, iv.1915, 3000-3460', 1 ♂ (MNKM), same data but with: Pres. Raffles Mus. Singapore, Brit. Mus. 1922-302, 1 ♂ (BMNH); Bukit Kutu, 3300 ft, A.R. Sanderson, Brit. Mus. 1933-523, 3 ♂, same data but with: 1920-1925, 3 ♂ (BMNH); Hulu Langat, Sg. Congkak, 27-29.xi.1992, Zabidi & Badrol, 1 ♂ (UKM); Kuala Lumpur, ix.1916, ex. coll. Agr. Dept., ex F.M.S. Museum, B.M.1955-354, 1 ♂ (BMNH); Selangor, Pahang, Semangko Pass, 2700', iii.1912, Pres. Raffles Mus. Singapore, Brit. Mus. 1922-302, 1 ♂ (BMNH); Tanjung Karang, 13.x.90, Ruslan, 1 ♂ (UKM); NEGERI SEMBILAN: Pasoh Forest Reserve, 0.9 km ENE station quarters, 10 km W Ayer Hitam, 350 m, 8.xii.1996, at light, M. Kos & S. Azman, trail between primary forest and buffer zone, 1 ♂ (ZMA); MELAKA:

Asahan, Gunung Ledang, 28-29.iii.1995, Ruslan & Ismail, 1♂ (UKM); JOHORE: Johor, Pulo Pisang, 28.ii.1925, Ex F.M.S. Museums, B.M. 1955-354, 1♂ (BMNH). – SABAH: Danum Valley, 5°01'N 117°47'E, 220 m, 10.ix.1987, light trap sample, roadside secondary forest, NMW Sabah (Borneo) Expedition, NMW.Z.1987.094, A.H. Kirk-Spriggs, 1♂, same labels but: 120 m, 17.x.1987, primary forest edge, 4♂ (NMW); Danum Valley, Danum Valley Fld Centre, 100-200 m, 18-29.x.1987, multistr. evergr. forest along river, at light, Krikken & Rombaut, 4♂ (RMNH); 60 km W of Lahad Datu, DVFC, nr Segama bridge, 4°58'N 117°48'E, 150 m, 20.x.1987, J. Huisman & R. de Jong, 1♂ (RMNH); 60 km W of Lahad Datu, Danum Valley Field Centre, at junction Sg Segama and Sg Palum Tambun, road DVFC-kg Silam nr. km 68.5, 4°58'N 117°48'E, 150 m, 24.iii.1987, at light, 18.30-21.00, disturbed evergr. lowland rainforest, leg. Van Tol & Huisman, 1♂ (ZMA); Danum Valley, 70 km W Lahad Datu, Field Centre, Main Trail West 0 North 5, 150 m, 15.xii.1989, sample Sab. 69, secondary vegetation/canopy/primary forest margin, at light, M.J. & J.P. Duffels Lembah Danum, 15.ii.1994, John, 1♂ (UKM); Lembah Danum, 3-5.xii.1991, Zaidi, Is, Lan, Yus, 1♂ (UKM); Lembah Danum, 25-30.viii.1991, M.S., Zaidi, Mail, Lan, 3♂ (UKM); Lembah Danum, 22-26.viii.1992, Ismail, Sham & Yusof, 20 m, (UKM); Lembah Danum, 22-28.viii.1992, coll. Masitah,

1♂, same locality and date but coll. Norhayani A.B., 1♂, coll. S. Endang, 1♂ (UKM); Lembah Danum, 16.ix.1995, Zaidi, 11♂ (UKM); Jesselton, 2.xii.1967, P.J.L. Roche, Brit. Mus. 1990-24, 1♂ (BMNH); 24 km on rd. Keningau - Kumanis (N. side), 116°03'E 5°27'N, 1350 m, 19.xi.1987, J. Huisman & R. de Jong, 2♂ (RMNH); Mt. Kinabalu, Tenom Keningau, 4-8.iii.1964, J. Smart, Royal Soc. Exped., B.M.1964-250, 1♂ (BMNH); Keningau area, Nabawan (resthouse), 450 m, 14-18.xi.1987, Krikken & Rombaut, 2♂ (RMNH); 20 km W Sandakan, Sepilok-laut, nr. Resthouse, 118°06'E 5°49'N, 4.xi.1987, 0 m, ML-light, J. Huisman & R. de Jong, 1♂ (RMNH); 39 km road Keningau - Nabawan, Sg Sook, 116°E 5°N, 350 m, 17.xi.1987, J. Huisman & R. de Jong, 1♂ (RMNH); Kinabatangan, Batu Putih, 6-15.iv.1994, Nordin Wahid, 3♂ (UKM); Kota Kinabalu, Tenom, 3.viii.1989, D. Shasi, 1♂ (UKM); 23 km W Sandakan, Sepilok, tree tower, 118°06'E 5°49'N, 1.xi.1987, 0-100 m, ML, J. Huisman & R. de Jong, 4♂ (RMNH); Sandakan Dist., Rumidi, R. Labuk, 16-30.ix.1973, C. Pruett, B.M. 1975-590, 4♂ (BMNH); 15 km NW Kg. Sapulut, Kg. Labang, Sg. Saburan, 116°36'E 4°42'N, 300 m, 1.v.1987, ML-light, J. Huisman, 2♂ (RMNH); Tawai Plateau, 1300', 8.ix.1977, M.E. Bacchus, B.M. 1978-48, 1♂ (BMNH); Tawau, Brumas Camp, ix.1974, C. Pruett, B.M. 1975-590, 4♂ (BMNH); Tawau, Maliau Basin, 12-



13

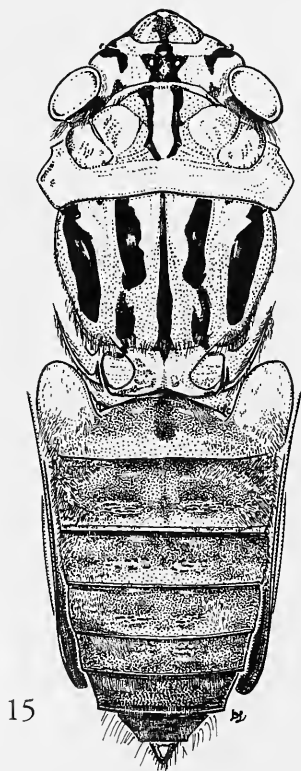


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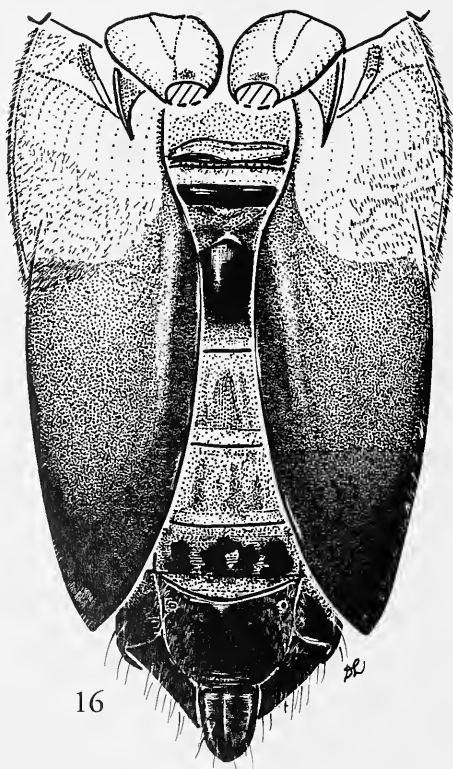
Figs. 13, 14. Male pygofer in ventral view. – 13, *Orientopsaltria padda*, Sabah, 23 km W Sandakan, Sepilok; 14, *Orientopsaltria saudarapadda*, Peninsular Malaysia, Penang, holotype.

25.v.1996, light trap, 1♂ (UMS); Tawau, Taman Bukit Tawau, 1-13.v.1992, Ruslan, 3♂ (UKM); Kalabakan, Tawau Residency, 14-15.xi.1958, L.W. Quate & T.C. Maa collectors, M.V. light trap, 1♂ (BPBM); Tenom, Lagrud Sebrang, 20.viii.1990, Yoing & S. Mul., 2♂, same data but coll. Fatimah, 1♂ (UKM); 16 km NE Tenom, Agr. Res. Station, resthouse, 115°59'E 5°12'N, 270 m, 22.xi.1987, J. Huisman & R. de Jong, 2♂ (RMNH). – SARAWAK: Bau, J.M. Bryan, B.M. 1931-150, 1♂ (BMNH); Bintulu, 14.viii.1994, Zaidi & Talib, 5♂ (UKM); Bintulu, Kampus UPM, 10.iii.1992, Zaidi, 4♂ (UKM); Bukit Kretam, 1952, J.D.H. Hedley, B.M.1952-612, 1♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 27.ix.1932, old secondary forest, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 1♂ (BMNH); Julau, Lanjak Entimau, 28-29.ii.92, Zaidi, 1♂ (UKM); Kedurong, ix.1910, J.C. Moulton, 1911-141, 2♂ (BMNH); Kedurong, 1910, 1912-307, 1♂ (BMNH); Kuching, 1-12, J.M. Bryan, B.M. 1931-150, 1♂ (BMNH); Kuching, 1.13, 2♂ (BMNH); Miri, Lambir N.P., 13-15.1992, Zaidi, 1♂ (UKM); Saribas, x.1922, 1♂ (MNKM). – INDONESIA, KALIMANTAN: Balikpapan, 7.ii.1929, Prince Léopold, R. I. Sc. N. B. I. G. 17.979, 1♂ (KBIN); Balikpapan, i.1946, R. van Veen, 3♂ (RMNH); Boentok, Barito Riv., G.C. Shortridge, 1910-123, 1♂ (BMNH); Long Nawang, leg. Mjöberg, 1925, 3♂ (ZMA);

Long Bagun, 25 km SE of Longboh, S. Mahakam, 7.iv.1996, R. Sözer, 3♂, same data but 21.xii.1995, 1♂ (ZMA); Long Pahangai, S. Mahakam, 20.xii.1995, R. Sözer, 1♂ (ZMA); Pontianak, R. Oberthür, 1898, 1♂ (MNP); Pontianak, Muir coll., 1♂ (BPBM); Pontianak, Max Weber, Borneo Exp., 1♂ (ZMA); Samarinda, 9.ii.1929, Prince Léopold, 1♂ (KBIN); Sanga Sanga, H.D. Jensen, 1907-203, 1♂ (BMNH); Tiong Buu (= Nahabuan), 18 km NW of Longkay, S. Mahakam, 15.iv.1996, R. Sözer, 8♂ 1♀ (ZMA); S. Unke, tributary of S. Penyelayan, S of Sintang and S of Kotabaru, 23.xi.1997, R. Sözer, 1♂ (ZMA); Wanariset near Samboja, 40 km N of Balikpapan, 8.xii.1988, M.M.J. van Balgooy, 1♂ (RMNH). – SUMATRA: Deli, L.P. de Bussy, ex alcohol, 9♂ (ZMA); Deli, 1♂ (KBIN); Djambi, G. Aalbertsberg, 1♂ (RMNH); Djambi, 1909, P. Molenburgh, ex alcohol, 1♂ (ZMA); Fort de Kock, iii.1915, Edw. Jacobson, 1♂ (RMNH); Indragiri, A.L. v. Hasselt, 1895, 1♂ (RMNH); Kuala Simpang, xii.1953, A. Sollaart, lowland cultivated area, on light, 3♂, same data but: i.1954, 1♂, ii.1954, 1♂ (RMNH); Padang, 23.ix.1887, J. v.d. Hoeven, 1♂ (RMNH); Palembang, Mc Gillavry, 1♂ (ZMA); Riouw, 1901, Kluit, 1♂ (ZMA); Ris. Pasanocli, Padang, Sidempocan, 1894, A.L. v. Hasselt, 1♂ (RMNH); W. Sumatra, Lebong Tandai, 1920-1923, C.J. Brooks, B.M.1936-681, 2♂ (BMNH); L. Tandai, xii.1919, G.J. Brooks, 1♂ (BMNH); Sumatra, coll. Galasch,



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Figs. 15, 16. *Orientopsaltria saударapadda*, Peninsular Malaysia, Penang, male holotype. – 15, body in dorsal view; 16, abdomen with percula in ventral view.

1♂ (ZFMK). — CHINA: China, 2♂ (SEM); Tonkin China, Wm. T. Davis Collection, Cornell U. Lot. 732 sub. 15, 1♂ (CUIC).

*Orientopsaltria cf paddy*: THAILAND: Khao Soi Dao, 300 m, 10.viii.1987, T.W. Harman, 1♂ (ZMA); Chantaburi, Khao Soi Dao, c. 400 m, 24-25.viii.1987, leg. S. Moriuti, T. Saito, Y. Arita & Y. Yoshiyasu, Lepidopt. Exped. to Thai, 1987, Coll. Ent. Lab., Univ. Osaka Pref., 1♂ (OPU); Chantaburi, Phliu, 4.vi.1983, H. Kuroko, S. Moriuti, Y. Arita & Y. Yoshiyasu, Lepidopt. Exped. to Thai, 1983, Coll. Ent. Lab., Univ. Osaka Pref., 1♂ (OPU)

*Orientopsaltria saudarapadda* Duffels & Zaidi, 1998 (figs. 14-17, 20, 43, plate 1: 3)

*Orientopsaltria saudarapadda* Duffels & Zaidi, 1998: 317-319, 321, 330-339, figs. 7-10. Holotype ♂: 'MALAY PENIN:/Penang is./Nov. 1927', 'Ex F.M.S./Museum./B.M. 1955-354' (MNKM) [examined].

*Orientopsaltria saudarapadda* is probably endemic to Peninsular Malaysia. One specimen is labelled Samarinda, in Southeast Kalimantan, Borneo, but the occurrence of this species in Borneo needs confirmation.

*O. saudarapadda* differs from *O. paddy* in a somewhat larger body size, absence of lateral pronotal fasciae (fig. 15), coloration of the male operculum (fig. 16), and shape of the male uncus (fig. 14).

A full description of *Orientopsaltria saudarapadda*

has been given recently (Duffels & Zaidi 1998). *O. saudarapadda* differs from *O. paddy* in several external features. The body size of *saudarapadda* (body length males in mm (n= 20): 36.8-41.4 mm (38.7±1.2)) is somewhat larger than in *paddy* (body length males in mm (n= 20): 34.9-38.9 mm (37.3±1.2)). The lateral pronotal fasciae running from the eye to the base of the tegmen, that characterize *paddy*, are absent in *O. saudarapadda* (fig. 15); the latter species has a small dark mark only along the inner margin of the ambient fissure. The male operculum of *O. saudarapadda* (figs. 16, 20) is dark brown to black-brown apically and along the median margin, while the remaining surface of operculum, proximally of the dark brown apical part, is reddish brown with exception of the ochraceous or light brownish basal one third or one fourth; the operculum of *O. paddy* (figs. 11, 19) is black to black-brown apically and along its medial margin, while its remaining surface is ochraceous without reddish brown coloration.

The two species also differ in the uncus of the male genitalia. The uncus lobes of *saudarapadda* (fig. 14) have a slightly medially curved, fairly stout lateral spine, which is as long as or slightly longer than the hook-shaped medial spine; the apical parts of the lateral margins of the uncus lobes are convex. In *paddy* (fig. 13) the lateral spine is straight and considerably longer than the medial spine, while the lateral margin

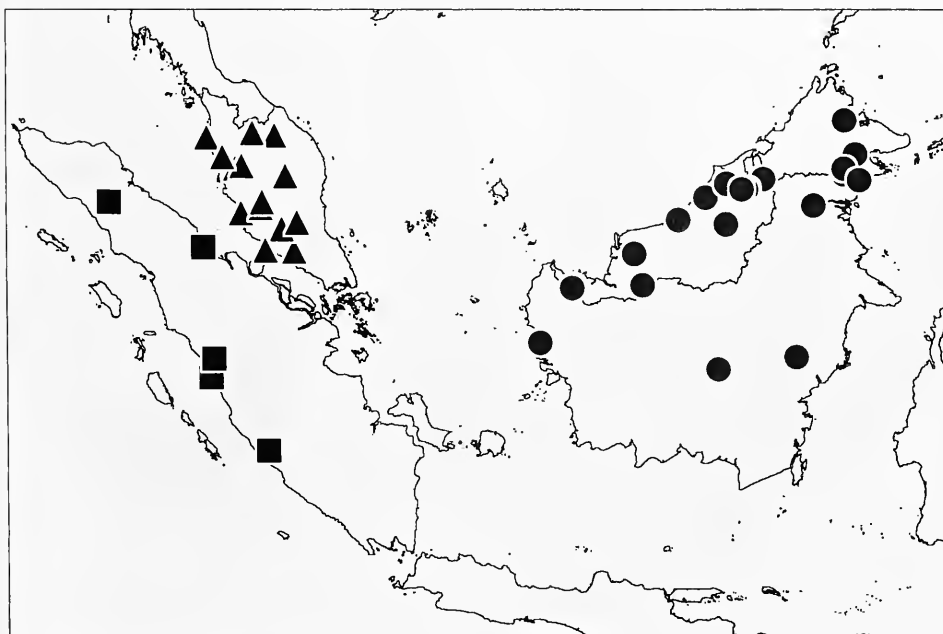


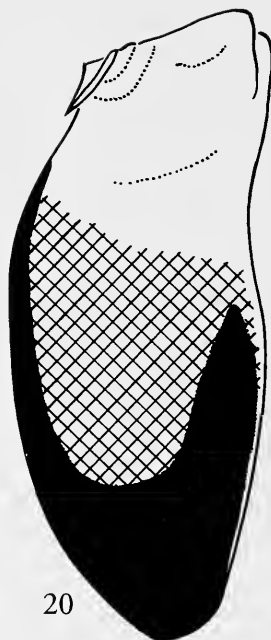
Fig. 17. Distributions of *Orientopsaltria saudarapadda* (triangles), *O. moultoni* (squares), and *O. agatha* (rounds).



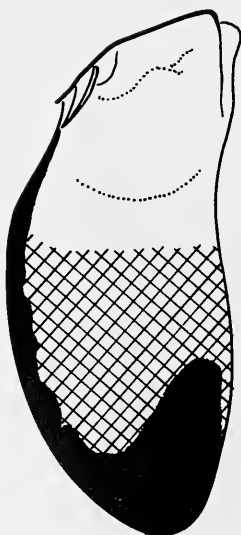
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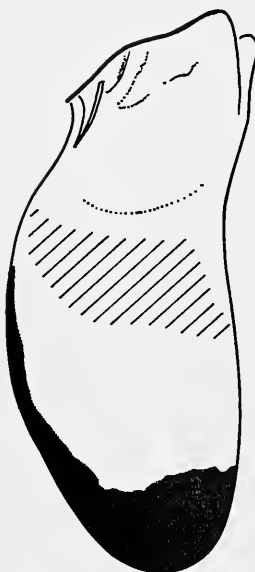
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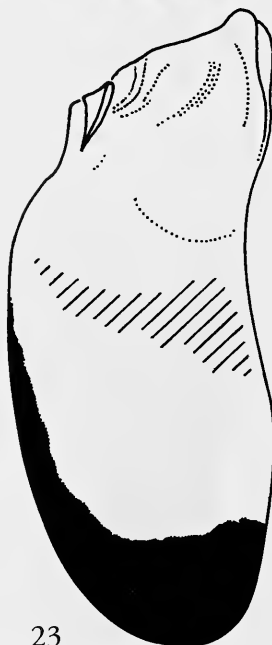
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23

Figs. 18-23. Male opercula of *Orientopsaltria* species in lateroventral view. – 18, *O. duarum*, Sumatra, Dumai; 19, *O. padda*, Sabah, 60 km W of Lahad Datu, Danum Valley Field Centre, at junction Sg Segama and Sg Palum Tambun; 20, *O. saudara-padda*, Peninsular Malaysia, Penang, male holotype; 21, *O. moultoni*, Sumatra, Prince Léopold; 22, *O. montivaga*, Sabah, Keningau - Kimanis road; 23, *O. ruslani*, male holotype, Peninsular Malaysia, Cameron Highlands, Tanah Rata.

of the uncus lobe is straight.

Measurements (body length  $n=20$  ♂, 1 ♀; other measurements  $n=6$  ♂, 1 ♀). – Body length ♂ 36.8–41.4 mm ( $38.7 \pm 1.2$ ), ♀ 33.5 mm; head width ♂ 12.0–13.5 mm, ♀ 12.5 mm; pronotum width ♂ 12.2–14.6 mm, ♀ 13.3 mm; tegmen length ♂ 48–55.5 mm, ♀ 51 mm..

***Orientopsaltria moultoni*** (China, 1926)

(figs. 17, 21, 24–26, plate 1: 4)

*Cosmopsaltria moultoni* China in: Moulton & China, 1926: 121, fig. a. Holotype ♂: 'Padang, Sumatra's Westkust, 2m, 1925, leg. E. Jacobson', 'ex alcohol', '*Cosmopsaltria* ? n. sp., det. J.C. Moulton, 1926', '*Cosmopsaltria moultoni* China, TYPE, det. W. E. China, 1926', 'TYPE' (BMNH) [examined].

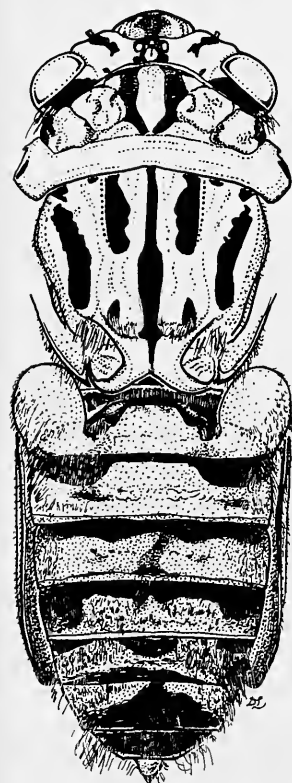
*Cosmopsaltria moultoni*; Myers 1929: 41, fig. 4; Metcalf 1963: 551.

*Orientopsaltria moultoni*; Duffels 1983: 9; Duffels & Zaidi 1998: 321.

*O. moultoni* is endemic to Sumatra (fig. 17). *O. moultoni* (fig. 24) resembles *padda*, *duarum*, *saudarapadda* and *agatha* in the broad lateral mesonotal fasciae. *O. moultoni* and *O. agatha* are the only species in

the genus with a median black line on the underside of postclypeus that widens to a black triangle at the clypeal suture. *O. moultoni* has a pair of black-brown lateral marks at the innerside of the lateral parts of the ambient pronotal fissure, but it is missing the lateral pronotal fasciae running from the eye to the posterior margin of the pronotal collar, as found in *duarum* and *padda*. The male operculum of *moultoni* (fig. 21) resembles that of *O. saudarapadda* (fig. 20) in the dark brown to black-brown colour along the medial and apical margins, that hardly contrasts with the reddish brown coloration of the remaining apical two thirds of the operculum. The male opercula of *padda*, *duarum*, and *agatha* are usually broader, black-brown to black coloured along the medial and apical margins; this coloration strongly contrasts with the ochraceous to light brownish remaining surface of the operculum.

The male genitalia of *moultoni* (fig. 26) are fairly similar to those of *padda* (fig. 13) in the uncus shape, but the basal pygofer lobes of *moultoni* have distinct protrusions as found in *montivaga* (fig. 29) and *agatha* (fig. 39). Such protrusions are lacking in *duarum*, *padda*, and *saudarapadda*.



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Figs. 24, 25. *Orientopsaltria moultoni*, Sumatra, Prince Léopold. – 24, body in dorsal view; 25, abdomen with operculum in ventral view.

## Description of male

**Head.** – Median black mark on dorsal side of postclypeus smaller than in *padda*. Fasciae running parallel to inner curve of eye reach from the vertex lobe to the level of the paired ocelli and unlike *padda*, do not continue to the posterior margin of the head. Black fascia on the underside of the head running from antenna to eye, as in *padda*. Marking on postclypeus as in *padda*, but *moultoni* has a very characteristic median, triangular, black mark, widening from oval spot at anterior margin of postclypeus to clypeal suture.

**Thorax.** – Pronotum. Paired central fasciae slightly widened anteriorly, posterior ends fused or almost fused. Proximal ends of anterior oblique fissures with brown mark fused with central fasciae. Posterior oblique fissures light brown; this brown coloration continues in lateral part of ambient fissure. A pair of conspicuous, black-brown marks at the innersides of the lateral parts of ambient fissure. Posterior rim of pronotal collar black, up to a lanceolate black-brown spot at half-length of lateral margin of collar.

**Mesonotum.** – Five fairly broad fascia. Median fascia as in *padda*, but posterior half 3-5× as wide as anterior part. Paramedian fasciae, spots in front of cruciform elevation, and pair of small black triangles as in *padda*. Lateral fasciae continuous from anterior to posterior margin of mesonotum, anterior part of fascia distinctly outcurved laterad.

**Legs** as in *padda*.

**Tegmina** with basal veins of 2nd and 3rd apical areas infuscated, and rarely with small spots at apices of longitudinal veins. Venation of tegmina and wings as in *padda*.

**Operculum** (figs. 21, 25). – Elongate, fairly broad, reaching to distal part of abdominal segment 6 or to half-length segment 7. Medial margin evenly convex. Lateral margin weakly convex in basal part, concavely sinuate at one third to one fourth of its length from base, and weakly convex in apical two thirds. The fairly narrow black to black-brown coloration along medial margin extends from one third of its length from base and only gradually widens to the black to black-brown apical one sixth of operculum. The remaining surface of the operculum, proximally of the dark apical part, is reddish brown with exception of the ochraceous to light brownish basal third. Lateral part and apical two thirds of operculum covered with silvery pubescence.

**Abdomen.** – Light brown with a greenish tinge to castaneous brown with black brown marking. Marking consisting of more or less conspicuous black-brown line along anterior margins of tergites; segment 2 often with a median, round or triangular spot at anterior margin reaching to one third of or half-length the segment; segments 2 and 3 with a pair of paramedian spots at anterior segment margins; segment 4 in

light-coloured specimens with a pair of paramedian spots situated at half the segment height; segments 5 and 6 with a bicuspidate medial mark at anterior segment margin, and sometimes laterally dark-coloured; segment 7 either with medial bicuspidate mark and lateral dark coloration, or dark-coloured without distinct marking; segment 8 dark-coloured.

**Genitalia** (fig. 26). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with converging parallel ridges, ending distally in a distinct rounded protrusion; basal pygofer lobes situated at considerable distance from lateral sides of pygofer. Uncus with large and distinctly globose basal part. Uncus lobes with fairly broad and stout, slightly outcurved, lateral spine, and with a shorter hook-shaped medial spine; lateral margin of uncus lobe slightly convex basally and weakly concave at two thirds of length from base. Arcuate ridge over narrow gap between uncus lobes fairly strongly elevated and outcurved.

**Measurements** (n= 6♂). – Body length 33-35 mm; head width 11.2-11.7 mm; pronotum width 11.6-12.4 mm; tegmen length 45-50 mm.

**Material examined.** – 13♂. INDONESIA, SUMATRA: Alas Valley, Balelutu, 3°43'N-97°38'E, 3-8.viii.1972, J. Krikken,

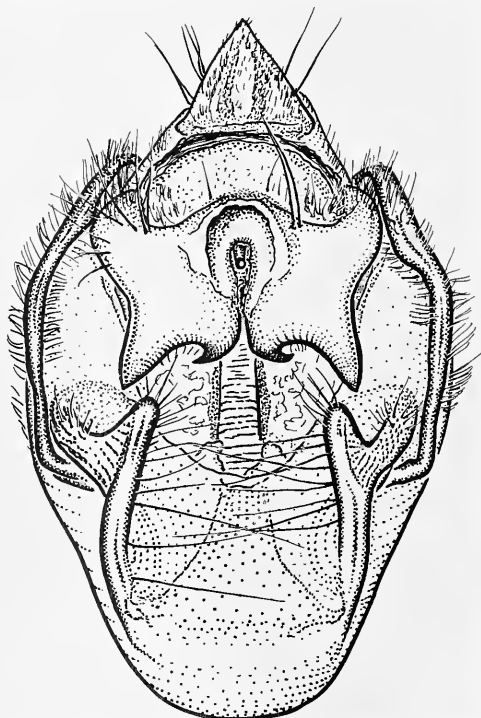


Fig. 26. *Orientopsaltria moultoni*, male pygofer in ventral view, Sumatra, Prince Léopold.

nos 36-40, ca 320 m, jk no 36, cult. space in lowland multi-stratal evergreen forest, at light, 2♂ (RMNH) 1♂ (ZMA); Benkoelen Dist., 1912-1019, C. J. Brooks, 1920-43, 2♂ (BMNH); Deli, L. P. de Bussy, ex alcohol, 3♂ (ZMA); Labuan, Bilik, 1922-23, Palm, Mus. Zool. Helsinki, HE 5329, 1♂ (MZHF); Lebang Tandai, 1912-5, C. J. Brooks coll., 1♂ (ZMA); Png Pandjang, Pad. Bovenland, 2000', 1ste trim. 1897, I. Z. Kannegijeter, 1♂ (BMNH); Sumatra, 4-5.1929, Prince Léopold, 1♂ (KBIN). — WITHOUT LOCALITY: 1♂ (ZMA).

### *Orientopsaltria montivaga* group

#### Diagnosis

The *montivaga* group consists of three fairly large-sized species (body length male: 32-42 mm): *O. montivaga*, *O. ruslani*, and *O. agatha*. The first two species have a vicariant distribution: *O. ruslani* is found in the Malayan Peninsula and Sumatra, while *O. montivaga* is an endemic of Borneo. *O. agatha* is an endemic of Borneo as well. The *montivaga* group is characterized by a fairly narrow, but distinct transverse fascia, just below the constriction of the male operculum, by a distinct cap over the apex of the aedeagus, and by the basal pygofer lobes which form high parallel ridges; the latter character is also found in *O. moultoni* of the *padda* group.

*Orientopsaltria montivaga* (Distant, 1889)  
(figs. 22, 27-32, 44, plate 2: 1)

*Cosmopsaltria montivaga* Distant, 1889a: 421. Holotype ♂ 'Kina Balu (Whitehead)', *montivaga* Dist., 'Type' (round label; red circle), 'Distant coll. 1911-383' (BMNH) [examined].

*Cosmopsaltria montivaga*; Distant 1890: 49; Distant 1892a: pl. 12 figs. 12, 12a-b; Distant 1905: 56; Breddin 1900: 176; Breddin 1905: 220; Distant 1906: 56; Moulton 1911a: 134, 140; Moulton 1911b: 186, 188-190; Distant 1912: 44; Moulton 1923: 88, 92, 95-96, 167 (partim: only the Borneo material); Singh Pruthi 1925: 191, pl. 19 fig. 142; Moulton 1928: 507; Kato 1932: 165.

*Orientopsaltria montivaga*; Kato 1944b: 10; Duffels 1968: 79-84 (partim: the text only as far as it refers to the Borneo material; the figs. 1-3 and the text about specimens from Sumatra refer to *O. ruslani*); Metcalf 1963: 558-559 (partim: references to material from Borneo only); Duffels 1983: 9; Duffels & Van der Laan 1985: 120 (partim: references to material from Borneo only); Zaidi 1993: 959, 960; Zaidi & Ruslan 1995b: 197, 203; Zaidi 1996: 97, 101, 104; Zaidi & Hamid 1996: 49, 50, 53, 56, 57; Zaidi 1997: 113, 116; Duffels & Zaidi 1998: 319-322.

[Misidentifications:

*Cosmopsaltria montivaga*; Moulton 1925: 434; Moulton & China 1926: 191.

*Orientopsaltria montivaga*; Zaidi et al. 1990: 263-265; Zaidi & Ruslan 1994: 426, 428, 429; Zaidi et al. 1996: 60.]

*Orientopsaltria montivaga* is restricted to the northern (Sabah, the northern part of Sarawak and

Brunei), and central parts (one locality in Kalimantan) of Borneo (fig. 32). *O. montivaga* is closely related to *O. ruslani* from Sumatra and the Malayan Peninsula. A previous study (Duffels & Zaidi 1998) revealed that the two species can only be separated by the shape of the uncus lobes. *O. montivaga* (fig. 28) and *O. ruslani* (fig. 34) have a fairly narrow, distinct transverse fascia, just below the constriction of the male operculum. This character is also found in *O. agatha* (fig. 38) from Borneo. A broader, more indistinct transverse fascia, situated on the apical two thirds of operculum, is also found in *O. guttigera* and relatives. *O. montivaga* (fig. 27) and *O. ruslani* can be easily separated from *O. agatha* (fig. 37) by the much narrower mesonotal fasciae, and by the basal pygofer lobes consisting of more or less parallel, protruding ridges at considerable distance from lateral sides of pygofer, while the basal pygofer lobes of *O. agatha* (fig. 39) are more or less triangular and sharply pointed.

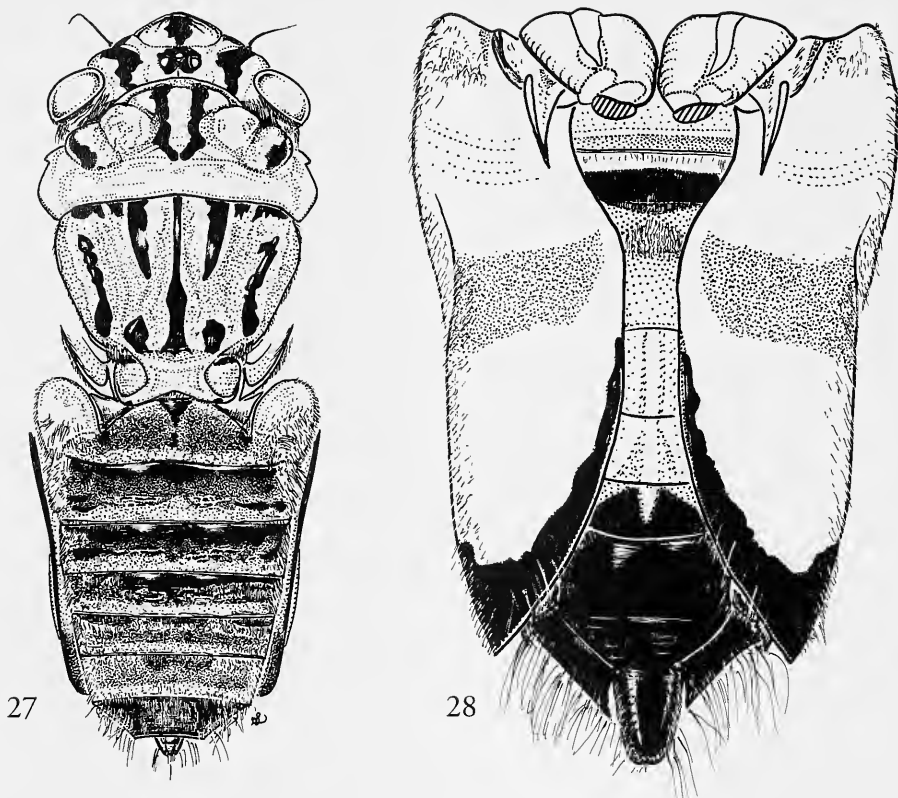
#### The identity of *Orientopsaltria montivaga* and synonymy

In 1925, Singh Pruthi made a weak attempt to synonymize *Cosmopsaltria agatha* Moulton, 1911 with *montivaga* by stating: 'The genitalia [of *agatha*] are identical with those in *C. montivaga*; both seem to be the same species'. This was in contradiction with Moulton (1923), who considered the two species quite distinct. Metcalf's catalogue (1963) followed Singh Pruthi and placed *Cosmopsaltria agatha* in the synonymy of *Orientopsaltria montivaga*. Later, the latter species was transferred by Kato (1944b) to the new genus *Orientopsaltria*. In 1968, Duffels stressed that *montivaga* and *agatha* differ in external features and male genitalia, and placed *C. agatha* as a separate species in the genus *Orientopsaltria*.

#### Description

Ground colour brown to ochraceous, sometimes with greenish tinge; pronotal collar often somewhat lighter than pronotal disk, and sometimes with greenish tinge.

Head. — Head from dorsal aspect with large, black, median mark, that encloses the ocelli, narrows distinctly to frontoclypeal suture, and continues on postclypeus in a lanceolate to round spot extending distad to median oval spot of the ground colour at anterior part of postclypeus; proximal margin of median mark trilobate, and not reaching posterior margin of head. A pair of irregular, broad fasciae run parallel to inner curve of eyes from vertex lobes to posterior margin of head, the fascia is anteriorly as wide as distance to eye but much narrower toward posterior margin of head. A fairly broad fascia runs from anterior dorsal part of supra-antennal plate to base of antenna, and continues on ventral side of vertex lobe toward eye.



Figs. 27, 28. *Orientopsaltria montivaga*, male. — 27, body in dorsal view, Sarawak, Gunung Api; 28, abdomen with opercula in ventral view, Sabah, Keningau - Kimanis road.

Anterior part of postclypeus with 4-7 transverse lines on either side, median ends of these lines connected by a line enclosing a ground coloured oval spot. Remaining part of postclypeus and anteclypeus unmarked. Rostrum dark brown to black apically; extending beyond hind coxae.

Thorax. — Pronotum. Paired central fasciae black, parallel, but with posterior one thirds converging at anterior margin of pronotal collar; fasciae widening anteriorly, and sometimes continuing in a narrow black line along very light-coloured rim at anterior margin of pronotum. A pair of narrow, brown to black, stripes is situated above proximal parts of anterior oblique fissures. A pair of large, black, lateral marks at innerside of lateral part of ambient fissure.

Mesonotum. — Five narrow, black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation, and occasionally ending in a black triangle on cruciform elevation. This fascia is anteriorly less than one sixth as wide as distance be-

tween median and paramedian fasciae, widens to 3-4 $\times$  its anterior width from half to two fifths of its length from base, and slightly narrows toward the posterior to 2-3 $\times$  its anterior width. Paramedian fasciae extending from anterior margin to about half-length of mesonotum, width of fascia 1.5-3 $\times$  as wide as anterior part of median fascia; distance between median and paramedian fasciae about 3-4 $\times$  as wide as paramedian fasciae. A pair of round black spots in front of anterior angles of cruciform elevation. Lateral fasciae consisting of a linear part extending from one fourth or one fifth of mesonotum length to nearly posterior margin of mesonotum and, in several specimens, a black mark at anterior mesonotal margin. Anterior part of linear lateral fascia as broad as to two-thirds as broad as its posterior part and usually about one third to one fourth as broad as distance between paramedian and lateral fasciae, but occasionally much narrower. A pair of small black triangles at anterior mesonotal margin between paramedian and

lateral fasciae.

**Legs.** – Fore femora with subapical black ring, a broad light brown band on upperside and a dark line connecting the spines along lower edge; hind femora on innerside with dark brown and distally broad fascia that narrows proximad. Fore tibiae black, except part of dorsal side; middle tibiae with distal two-thirds of dorsal side and about distal one third of ventral side black; hind tibiae black-brown at base and apex. Tarsi of fore and middle legs dark brown to black.

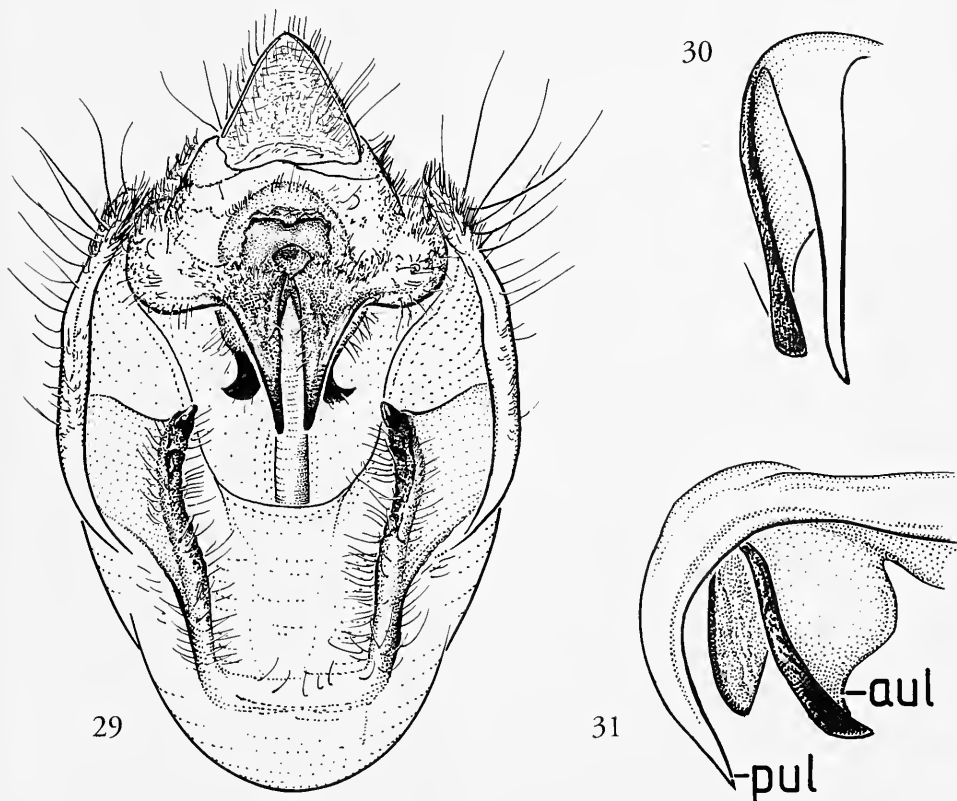
**Tegmina and wings.** – Hyaline sometimes with faint brownish suffusion. Tegmina with basal veins of 2nd and 3rd apical areas infuscated. Venation brown to black.

### Male

**Operculum** (figs. 22, 28). – Elongate and broad, reaching to half-length abdominal segment 7 or to

just beyond posterior margin of this segment. Medial margin evenly convex. Lateral margin convex in basal part, concavely sinuate at one third to one fourth of its length from base, and weakly convex in apical two thirds. Lateral, very narrow, rim of operculum black from base of operculum to black coloured apical one fifth or one sixth of operculum. Black coloration along medial margin gradually widens from one third of length from base to black apical part of operculum. A fairly narrow, transverse, castaneous fascia runs across middle of operculum.

**Abdomen.** – Segments 2 and 3 with a mediodorsal, dark brown to black, obconical to triangular spot of variable size at anterior segment margin; anterior two thirds of segment 2 red-brown to castaneous between medial corners of timbal coverings; anterior two thirds to three fourths of dorsal sides of segments 3-7 and whole surface of segment 8 red-brown to castaneous, though anterior one fifth to one sixth of seg-



Figs. 29-31. *Orientopsaltria montivaga*, male, Sarawak, Gunung Api. – 29, male pygofer in ventral view; 30, 31, anterior and posterior uncus lobes. – 30, in medioventral view; 31, in lateroventral view; aul: anterior uncus lobe, pul: posterior uncus lobe.

ments 3-5 often black to black-brown. Timbal coverings and hind margins of tergites ochraceous. Ventral side of abdomen light brown anteriorly and turning black-brown to the posterior.

Genitalia (figs. 29-31). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes forming slightly converging high parallel ridges, the distal ends of these ridges form short protrusions with a conical or sharp apex, which is in lateral view much broader than in ventral view; basal pygofer lobes situated at considerable distance from lateral sides of pygofer. Basal part of uncus with well-developed median cap over apex of aedeagus. Uncus lobes (figs. 30-31) with a pair of anterior and a pair of posterior lobes, which are distinctly separated. Posterior lobes broad at base, but a little more distad the lobes strongly narrow into their sharply pointed and strongly inwardly curved apices; lateral margins in ventral view basally concave, and straight or weakly concave to the juxtaposed apices of the uncus lobes. Anterior lobes, situated dorsally of posterior lobes, in ventral view elongate, medial margins straight and parallel or weakly convex, lateral margins basally convex and apically concave, apical part of lobe in ventral view rectangular and in lateral view recurved and pointed.

## Female

Operculum (fig. 44). – Brownish, reaching to halfway abdominal segment 3. Lateral margin undulate; laterodistal corner of operculum rectangular. Posterior margin straight and oblique, but medially distinctly convexly curved toward meracanthus.

Abdomen dorsally brown, with exception of the ochraceous posterior one sixth to one third of tergites 2-8, a pair of faint, lateral, brown spots on tergites 3-7 and a pair of paramedian faint, triangular, brown spots at anterior margin of tergite 9; ventrally light brown with a pair of paramedian, dark brown spots on sternite 7.

Measurements ( $n = 6\sigma$  1♀). – Body length ♂ 35-42 mm, ♀ 35 mm; head width ♂ 12.1-13.2 mm, ♀ 13.3 mm; pronotum width ♂ 12.9-14.4 mm, ♀ 14.0 mm; tegmen length ♂ 48-53 mm, ♀ 52.5 mm.

Material examined. – 116♂ 2♀. MALAYSIA: SABAH: Lembeh Danum, 15-20.v.1991, Zaidi, Ismail, Ruslan, 1♂ (UKM); Lembah Danum, 25-30.viii.1991, M.S., Zaidi, Mail, Lan, 2♂ (UKM); Lembah Danum, 27-31.viii.1991, Salleh, Zaidi, Mail, Lan, 1♂ (UKM); Danum Valley, Danum Valley Fld Centre, 100-200 m, 18-29.x.1987, multistr. evergr. forest along river, at light, Krikken & Rombaut, 1♂ (RMNH); Lahad Datu, L. Danum, 23.viii.1992, Dennes, 1♂ (UKM); Jesselton, i.1968, P.J.L. Roche, Brit. Mus. 1990-24, 1♂, same data but: 2.xii.1967, 1♂ (BMNH); Inanam, Klangsom, 22.ix.1991, Azmi Ibrahim, 1♂ (UKM); Kalabakan,

Tawau Residency, 14-15.xi.1958, L.W. Quate & T.C. Maa collectors, M.V. light trap, 1♂ (BPBM); 12 mi N of Kalabakan, Forest Camp, Tawau, Residuly, 19.x.1962, K.J. Kuncheria collector Bishop, light trap, 1♂ (BPBM); 19 km N of Kalabakan, Forest Camp, 25.x.1962, K.J. Kuncheria collector Bishop, 1♂, same data but: 30.x.1962, 1♂, 60 m, 27.x.1962, 1♂ (BPBM); 19 km N of Kalabakan, Forest Camp, 27.x.1962, Y. Hirashima, collector Bishop, 1♂ (BPBM); Keningau area, Nabawan (resthouse), 450 m, 14-18.ix.1987, Krikken & Rombaut, 1♂ (RMNH); R. Karamvak, Kunantong, 200', 3.ix.1977, M.E. Bacchus, B.M. 1978-48, 1♂ (BMNH); 24 km on rd. Keningau - Kimanis (N. side), 116°03'E 5°27'N, 1350 m, 19.xi.1987, J. Huisman & R. de Jong, 4♂ (RMNH); Mount Kinabalu, x.1978, Michel Duranton, 2♂ (MNP); K. Kinabalu, bkt Padang, HAMP, 1♂ (UKM); Kotakinabalu, Bukit Padang, 50 m, 24.viii.1988, Nor'Aini, 1♂, same locality but 4.viii.1988, Hamesah, 1♂ (UKM); Taman Kinabalu, Poring, 21-24.v.1991, Zaidi, Ismail, Ruslan, 1♂ (UKM); T. Negara, G. Kinabalu, 13-15.xii.1990, Zaidi, Ismail, Ruslan, 2♂ (UKM); K. Kinabalu, - Tambunan 64 km, 350 m, 21.viii.1989, 1♂ (UKM); Kotakinabalu, Bukit Padang, 50 m, 10.vii.1989, B. H. Lee, 1♂ (UKM); Menggatal Ck, 24.ix.1991, Abd. Manap M., 1♂ (UKM); Menggatal, UKMS, 20.ix.1990, H.K. Chan, R.A.J., 2♂ (UKM); Bukit Monkobo, 5°48'N 116°58'E, 1200 m, 21.viii.1987, A.H. Kirk-Spriggs, light trap sample, camp 1, stunted hill forest, NMW Sabah (Borneo) Expedition, NMW.Z. 1987.094, 2♂ (NMW); Sandakan Dist., Rumi-di, R. Labuk, 16-30.ix.1973, C. Pruett, B.M. 1975-590, 5♂ (BMNH); 16 km NE Tenom, Agr. Res. Station, resthouse, 115°59'E 5°12'N, 270 m, 22.xi.1987, J. Huisman & R. de Jong, 3♂ (RMNH); Sg. Manta kongan, 1.xii.1987, P. L., 00218, 1♂ (UKM); Tawau, Bukit Tawau, 1-13.v.1992, Ruslan, 1♂ (UKM); Tawau, Brumas Camp, ix.1974, C. Pruett, B.M. 1975-590, 7♂ (BMNH); Tenom, 25.ix.1987, Zakiah Abas, 1♂ (UKM); Tenom (Agr. Res. Station), 230 m, 23.xi.1987, gardens at light, Krikken & Rombaut, 1♂ (RMNH). – SARAWAK: Baram, 15.xi.1920, J.C. Moulton, 1♂ (MNKM); Bintulu, 14.viii.1994, Zaidi & Talib, 7♂ (UKM); Bintulu, UPM, 2-3.iii.1992, Zaidi, 4♂ (UKM); Claude town, 25.vii.1932, Primitive white sand forest, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 2♂ (BMNH); Mt. Dulit, 4000 ft, moss forest, 2.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 8.00-9.30 p.m., rainy & cold, at light in house, 7♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 10.ix.1932, in shady small clearing, old secondary forest, on bark of felled tree, 1♂ (BMNH); Julau, Lanjak Entimau, 28-29.ii.92, Zaidi, 7♂ (UKM); Limbang, Mendamit, 18-21.ii.1991, Zaidi, 1♂ (UKM); Gunung Mulu Nat. Park, Site 1, Camp 4, 452463, 1790 m, Lower montane (moss) forest, MV-Canopy, January, J.D. Holloway, RGS Mulu exped., B.M. 1978-206, 3♂, same data but: Site 14, Camp 2.5, Mulu, 413461, 1000 m, Lower l. montane forest, February, MV - canopy / understorey, 1♂ (BMNH), Site 16, Long Pala (Base), 324450, 70 m, Allu./second. forest, MV-on batu-Canopy, March, 1♂ 2♀ (BMNH), Site 23, W. Melinau Gorge, 430558, 250 m, FEG 4, limestone forest, April, MV - canopy / understorey, 1♂ (BMNH), Site 25, G. Api, 427550, 900 m, lower montane forest, MV and Act., 2♂, (BMNH), Site 26, G. Api, Pinnacles, 428525, 1200 m, open scrub, MV, 1♂ (BMNH), Site 27, G. Api, Pandanus Camp, 429541, 1500 m, Scrub Pandanus Act., April, 1♂ (BMNH); Kedurong, iii.1911, J. C. Moulton, 1911-141, 3♂ (BMNH); Kedurong, ix.1913, 1♂ (MNKM); Sibiu, 1-3.iii.92, Zaidi, 1♂

(UKM). – INDONESIA: KALIMANTAN: Long Bagun, 25 km SE of Longboh, S. Mahakam, 7.iv.1996, R. Sözer, 1 ♂ (ZMA). – BRUNEI: Badas, 50–100', Agathis/swamp for./secondary vegetation, 27.ii.1982, G.S. Robinson, BM 1982-156, 2 ♂ (BMNH); Belait, 11 km NW of 865 [B. Batam, Tempinak], 50 m, 4°22'N 114°35'E, secundair, 19.15–20.15, leg. E. F. de Vogel, 06011989, A.L., 2 ♂ RMNL; Bukit Pagon, LP 308, upper montane forest, 5520', 15–20.ii.1982, G.S. Robinson, BM 1982-156, 3 ♂ (BMNH); Penanjong coast, iii.1989, J.H. Martin coll., at light, B.M. 1989-89, 1 ♂ (BMNH); Rampayoh R. (north), LP 195, lowland for., 1–3.iii.1982, G.S. Robinson, B.M. 1982-156, 3 ♂ (BMNH); Temburong district, ridge NE of Kuala Belalong, approx. 300 m alt., x.1992, J.H. Martin coll., 125 m.v. light, B.M. 1992-172, 1 ♂, same data but: xi.1992, 2 ♂ (BMNH).

***Orientopsaltria ruslani* Duffels & Zaidi, 1998**  
(figs. 23, 32–36, 45, plate 2: 2)

*Orientopsaltria ruslani* Duffels & Zaidi, 1998: 317–319, 321–330, 333, figs. 1 (wrong figure depicted), 2–6. Holotype ♂: 'PAHANG: Cameron / Highland, Tanah Rata / 14–16 Okt. 1987 / Salleh, Ismail & Nor' (UKM) [examined]. – Duffels & Zaidi 1999: 147–148.

*Cosmopsaltria montivaga*; Moulton 1923: 88, 92, 95–96, 167 (partim: the Malayan Peninsula and Sumatra material only); Moulton 1925: 434; Moulton & China 1926: 191; Moulton 1928: 507 (partim: the records for the Malayan Peninsula and Sumatra only).

*Orientopsaltria montivaga*; Mercalf 1963: 558–559 (partim:

the references to material from Malayan Peninsula and Sumatra only); Duffels 1968: 79–84 (partim: figs. 1–3; the text only as far as it refers to material from Sumatra); Duffels 1983: 9; Duffels & Van der Laan 1985: 120 (partim: references to material from Malayan Peninsula and Sumatra only); Zaidi et al. 1990: 263–265; Zaidi & Ruslan 1994: 426, 428, 429; Zaidi et al. 1996: 60.

*Orientopsaltria ruslani* is very closely related to *O. montivaga*. The two species have been mixed up until recently (Duffels & Zaidi 1998). Our study has shown that *Orientopsaltria ruslani* is found in Sumatra and Peninsular Malaysia, and that *O. montivaga* occurs in Borneo (fig. 32). The two species do not show any differences in external features like the body marking, and share a pair of anterior and posterior uncus lobes; the latter character is regarded as a synapomorphy for the two species.

However, the posterior uncus lobe of *ruslani* (figs. 33, 35, 36) is much broader than that of *montivaga* (figs. 29–31). The apical half of the posterior lobe in *ruslani* has a slightly inwardly curved convex surface, and narrows, fairly suddenly, at about two thirds of length to a sharply pointed and somewhat darker coloured apex; the lateral margins of the posterior lobes are concave at base and more or less parallel or slightly convergent toward apex, while the basal two

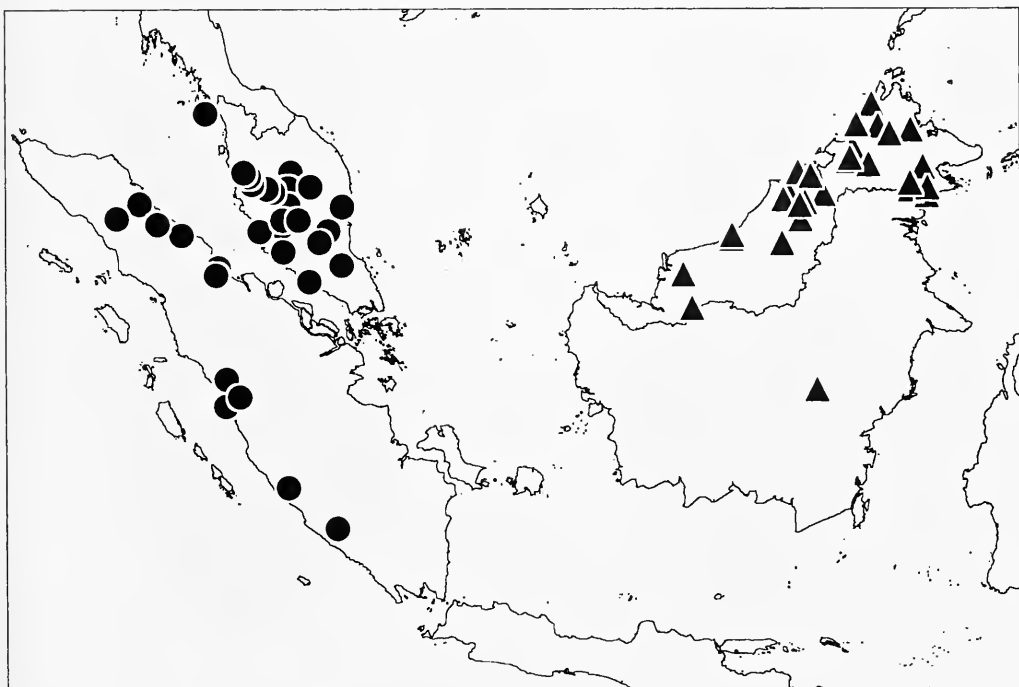
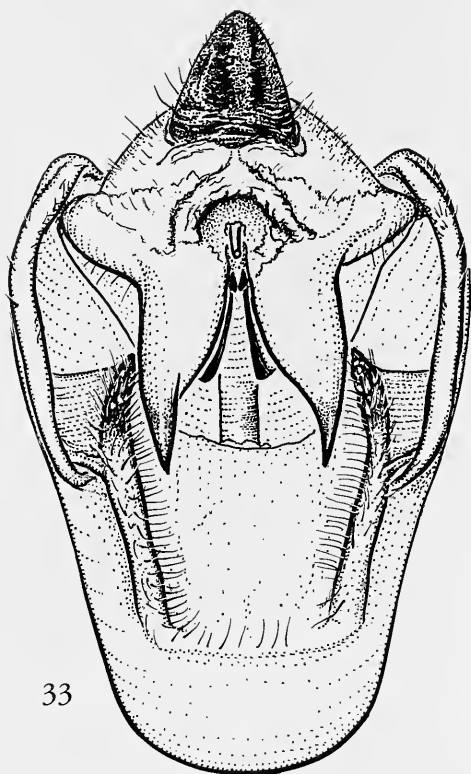
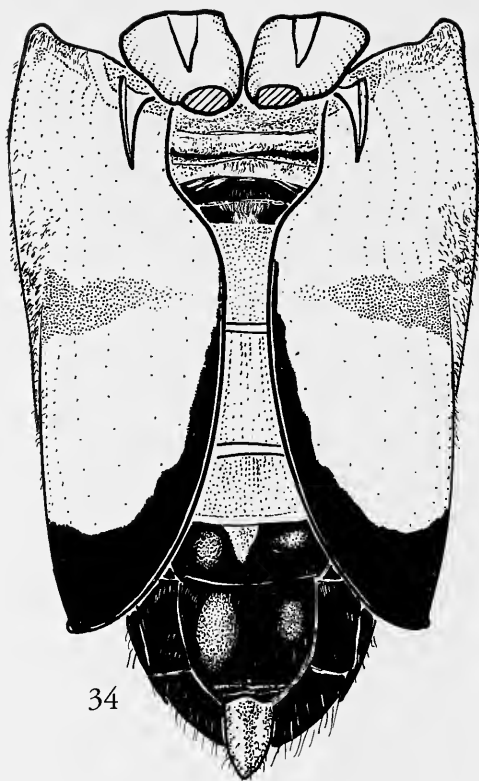


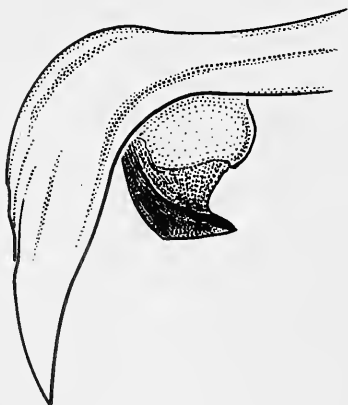
Fig. 32. Distribution of *Orientopsaltria ruslani* (rounds) and *O. montivaga* (triangles).



33



34



35



36

Figs. 33-36. *Orientopsaltria ruslani*, male holotype, Peninsular Malaysia, Cameron Highland, Tanah Rata. – 33, pygofer in ventral view; 34, male abdomen with opercula in ventral view; 35, 36, right anterior and posterior uncus lobes, 35, in lateroventral view, 36, in medioventral view.

thirds of the medial margins are fairly convex to the narrowed apical parts of the lobes. The anterior uncus lobes are similar to those in *montivaga*.

The material of this species has been listed in Duffels & Zaidi (1998); its distribution is given in fig. 32.

***Orientopsaltria agatha* (Moulton, 1911)**  
(figs. 17, 37–41, 63, plate 2: 3)

*Cosmopsaltria agatha* Moulton, 1911a: 187–190. Holotype ♂: 'Kedurong, Light House, 1910', 'TYPE ♂, *Cosmopsaltria agatha* Moulton', 'Type', '1912–307' (BMNH) [examined].

*Cosmopsaltria agatha*; Moulton 1923: 88, 92, 95, pl. 2, figs. 1, 1a–b; Singh-Pruthi 1925: 191; Moulton 1928: 508; Metcalf 1963: 560 (in syn. of *Orientopsaltria montivaga*); *Cosmopsaltria* sp. aff. *agatha*; Endo & Hayashi 1979: 38 (mentions a female from Mindanao, which is probably not *agatha*).

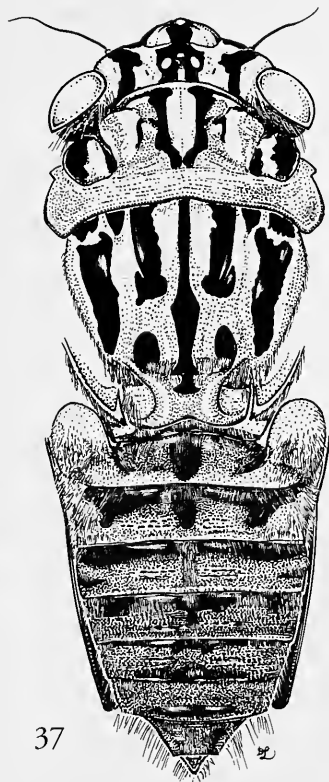
*Cosmopsaltria montivaga* var. *agatha*; Distant 1912: 44; *Orientopsaltria agatha*; Duffels 1968: 79–81, 83, fig. 4; Duffels 1977: 24; Duffels 1983: 4, 9; Duffels & Van der Laan 1985: 119; Zaidi 1993: 959, 960; Zaidi 1996: 97, 98, 101, 104; Zaidi & Hamid 1996: 49, 50, 53, 56, 57; Zaidi 1997: 113, 114, 116.

Up to now this species was only recorded from Sarawak (Moulton 1923, Duffels 1968), but the new material studied shows that the species also occurs in Sabah, Brunei and Kalimantan (fig. 17). *Orientopsaltria agatha* has a distinct transverse bar on the male operculum (fig. 38) and two spots on the tegmina but does not show any traces of marginal spots, a combination of characters that is also found in *O. montivaga* and *O. ruslani*. *O. agatha* can be separated from these two *Orientopsaltria* species by its much broader mesonotal fasciae (fig. 37). *O. agatha* can also be separated from *montivaga* and *ruslani* by the sharply pointed protrusions of the basal pygofer lobes and the absence of distinct anterior and posterior uncus lobes, though the underside of each uncus lobe is provided with a mediodorsal triangular keel (figs. 39–41).

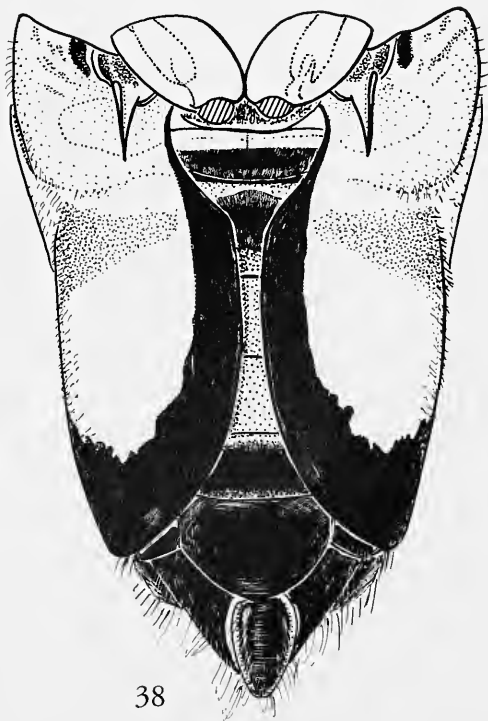
**Description of male**

Ground colour brown. The present species differs from *O. montivaga* in the following features:

Head. – With two short black lines extending from



37



38

Figs. 37, 38. *Orientopsaltria agatha*, male. – 37, body in dorsal view, Brunei, ridge NE of Kuala Belalong; 38, abdomen with opercula in ventral view, Sabah, Danum Valley, Krikken and Rombaut.

black mark enclosing ocelli to posterior margin of head, and a median, brown to black, triangle at frontoclypeal suture.

Thorax. – Pronotum as in *montivaga* but the triangular areas between central fasciae and anterior oblique fissures are for the greater part brown to black, and there is an extra pair of spots of variable size between anterior and posterior fissures.

Mesonotum (fig. 37). – With much broader fasciae than in *montivaga* (fig. 27). Median fascia anteriorly about half as wide as distance between median and paramedian fasciae, at three fifths of its length widened to  $3\times$  its anterior width, and posteriorly narrowed toward cruciform elevation. Paramedian fasciae slightly broader than distance between median and paramedian fasciae. A pair of round black spots in front of cruciform elevation. Lateral fascia either extending from anterior to posterior mesonotum margin or consisting of a black mark at anterior

mesonotum margin and a broad fascia extending from one fifth of mesonotum length to nearly posterior margin of mesonotum; this fascia is anteriorly  $1.5\times$  as wide as, and posteriorly slightly wider than, distance between paramedian and lateral fascia. A pair of fairly large black triangles at anterior mesonotal margin between paramedian and lateral fasciae.

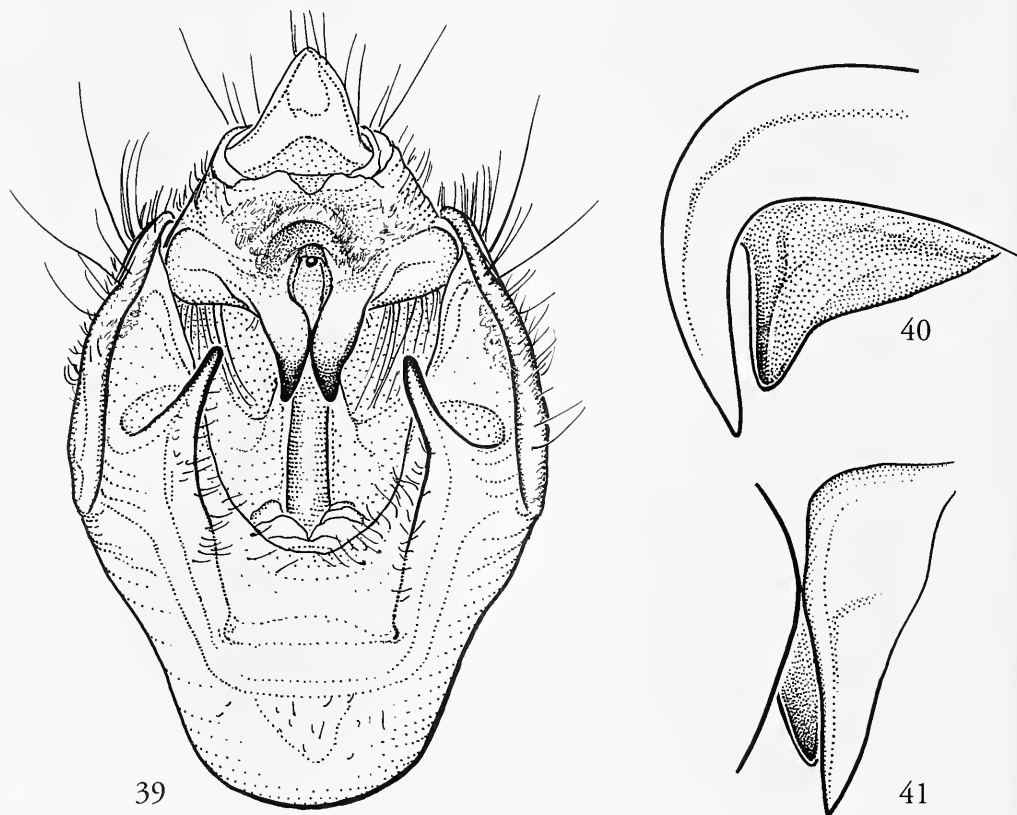
Legs as in *montivaga*.

Tegmina and wings as in *montivaga*.

Operculum (figs. 38, 63). – As in *montivaga*, but *agatha* may differ in the often more convex apical two thirds of the medial margin, and the more extended black coloration along this margin.

Abdomen as in *montivaga*.

Genitalia (figs. 39–41). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes forming fairly strongly converging high parallel ridges with long, sharply pointed protrusions, which are



Figs. 39–41. *Orientopsaltria agatha*, male. – 39, pygofer in ventral view, Sabah, Danum Valley, Krikken and Rombaut; 40, 41, uncus lobe, Kalimantan, Malinau. – 40, in lateroventral view; 41, in medioventral view.

narrowly triangular in lateroventral view; ridges of basal pygofer lobes situated at considerable distance from lateral sides of pygofer. Basal part of uncus with well-developed median cap over apex of aedeagus. Uncus lobes juxtaposed, strongly narrowing and convex toward sharply pointed incurved apices; each lobe provided with a mediodorsal triangular keel, that is only visible in lateral view and often hardly discernible.

Measurements (n = 5♂). – Body length 32–35.5 mm; head width 11.8–12.6 mm; pronotum width 12.4–13.5 mm; tegmen length 48–50.5 mm.

Material examined. – 110♂. MALAYSIA: SABAH: Lembah Danum, 16.ix.1995, Zaidi, 1♂ (UKM); Kalabakan, Tawau Residency, 14–15.xi.1958, L.W. Quate & T.C. Maa collectors, M.V. light trap, 1♂ (BFBM); 19 km N of Kalabakan, Forest Camp, 25.x.1962, Y. Hirashima, collector Bishop, 1♂, same label but: 23.x.1962, Light Trap, 1♂ (BFBM); Headquarters Mt. Kinabalu, 3–5.iv.1979, Y. Gunji, Natn. Sci. Mus. Tokyo: Loan No. He-97-010, 1♂ (NSMT); Sandakan Dist., Rumidi, R. Labuk, 16–30.ix.1973, C. Pruett, B.M. 1975–590, 1♂ (BMNH); Tawau, Brumas Camp, xi.1974, C. Pruett, B.M. 1975–590, 2♂ (BMNH). – SARAWAK: Baram, 12.ix.1920, J.C. Moulton, 1♂ (MNKM); Sarawak, Batu Niah, xii.1980, A. Harman, B.M. 1984–301, 1♂ (BMNH); Bau, vi.11, J. M. Bryan, B.M. 1931–150, 1♂, same data but ix.11, 1♂ (BMNH); Bidi, 1907–1908, 1♂ (BMNH); Bintulu, 18.i.1992, Zaidi, 1♂ (UKM); Bintulu, UPM, 2–3.iii.1992, Zaidi, 4♂ (UKM); Bintulu, Kampus UPM, 10.iii.1992, Zaidi, 5♂ (UKM); Bintulu, Pekan, 3.iii.1992, Zaidi, 10♂ (UKM); Claudetown, 25.vii.1932, primitive white sand forest, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933–254, 3♂ (BMNH); Julau, Lanjak Entimau, 28–29.ii.92, Zaidi, 17♂ (UKM); Gunung Mulu Nat. Park, Site 1, Camp 4, 452463, 1790 m, Lower montane (moss) forest, MV-Canopy, January, J.D. Holloway, RGS Mulu exped., B.M. 1978–206, 1♂, same data but: Site 14, Camp 2.5, Mulu, 413461, 1000 m, Lower I. montane forest, February, MV - canopy / understorey, 2♂ (BMNH), Site 26, G. Api, Pinnacles, 428525, 1200 m, open scrub, MV, 3♂ (BMNH); Kedurong, ii.1911, J.C. Moulton, 1911–141, 1♂, same data but iii.1911, 1♂ (BMNH); Kedurong, Light-House, 22.xii.1913, J.C. Moulton (Sarawak Museum), 1♂ (BMNH); Kedurong, Light House, i.1912, 1912–307, 1♂ (BMNH); Kedurong ix.1913, 2♂ (MNKM); Mt. Dulit, 4000 ft, moss forest, 26.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933–254, 2♂ (BMNH); Mt. Dulit, 4000 ft, moss forest, 22.x.1932, native collected, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933–254, 1♂, same data but collected in light trap, 1♂ (BMNH); Mt. Dulit, 4000 ft, moss forest, 2.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, T.H. Harrison, 8.0–9.30 P.M., rainy & cold, at light in house, B.M. 1933–254, 3♂ (BMNH); Mt. Dulit, 4000 ft, moss forest, 25.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, T.H. Harrison, B.M. 1933–254, 1♂, same data but 26.ix.1932, 1♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 29.viii.1932, light trap 5, old secondary forest, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933–254, 1♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 10.x.1932, native col-

lected, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933–254, 1♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 23.viii.1932, at light in house, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933–254, 1♂ (BMNH); Sibul, 1–3.iii.92, Zaidi, 1♂ (UKM); Tanjung, ix.1959, D. H. Elliott, B.M. 1959–603, 1♂ (BMNH); Sarawak, 14.viii.1994, Zaidi & Talib, 23♂ (UKM). – BRUNEI: Temburong district, ridge NE of Kuala Belalong, approx. 300 m alt., x.1992, J.H. Martin coll., 125 m.v. light, B.M. 1992–172, 1♂ (BMNH); Bukit Pagon, LP 308, upper montane forest, 15–20.ii.1982, 5520', G.S. Robinson, BM 1982–156, 1♂ (BMNH). – INDONESIA: KALIMANTAN: Kalimantan Timur (E. Borneo), Malinau, Natn. Sci. Mus. Tokyo: Loan No He-97-019, 1♂ (NSMT); Pontianak, vii.1907, Muir Coll., 1♂ (BFBM); Sintang, E. Wilmar, 1♂ (RMNH); Tiong Buu (= Nahabuan), 18 km NW of Longkay, S. Mahakam, 15.iv.1996, R. Sözer, 2♂ (ZMA); Tanjungisuy, Danau Jempang, 15.v.1996, R. Sözer, 1♂ (ZMA).

### *Orientopsaltria brooksi* group

#### Diagnosis

The *brooksi* group comprises only one species: *O. brooksi* from the Malay Peninsula and Sumatra. *O. brooksi* is a medium-sized species (body length male: 27.5–30.5 mm) with long and narrow lateral mesonotal fasciae reaching to anterior margin of mesonotum. Such long lateral fasciae are also found in the *padda* group, and in *O. agatha* of the *montivaga* group, but in these species the mesonotal fasciae are much broader than in *O. brooksi*. The male uncus of *O. brooksi* is structurally similar to *O. padda* and its relatives.

#### *Orientopsaltria brooksi* (Moulton, 1923)

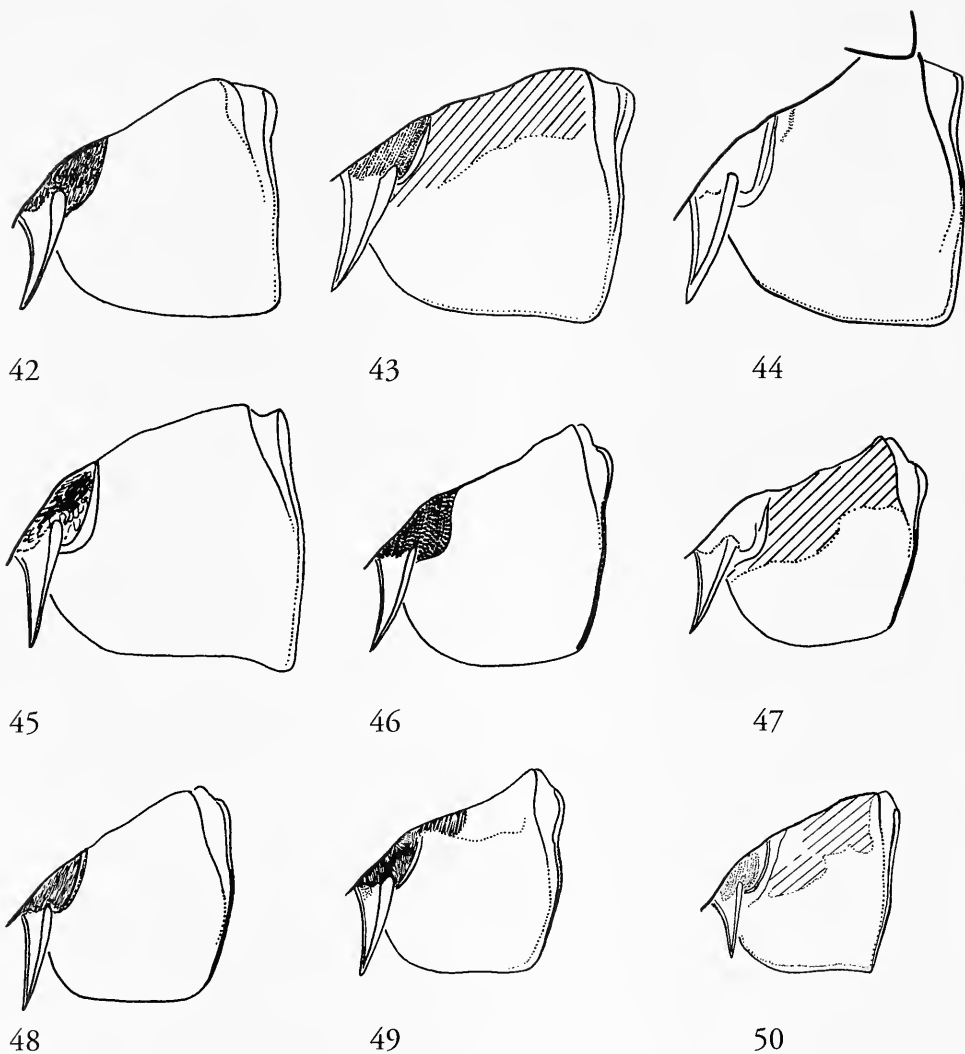
(figs. 51–55, 64, plate 2: 4)

*Cosmopsaltria brooksi* Moulton, 1923: 69, 88, 93–95, 167. Holotype ♂: 'Bencoelen, Sumatra, C. J. Brooks, 1922', '1923–355 Brit. Mus.', '9328', 'Type H.T.' (round label; red circle), '*Cosmopsaltria brooksi* Moulton, TYPE ♂, 29.iv.23' (BMNH) [examined].

*Orientopsaltria brooksi*; Duffels 1983: 9; Zaidi 1993: 958–960; Zaidi & Ruslan 1995a: 64, 65, 68; Zaidi & Ruslan 1995b: 198, 200, 201, 203; Zaidi 1996: 97, 98, 101, 104; Zaidi & Hamid 1996: 50, 53, 56, 57; Zaidi 1997: 113, 114, 116; Duffels & Zaidi 1998: 321.

This species is recorded from Sumatra and Pahang, Peninsular Malaysia (Moulton, 1923; Zaidi & Ruslan 1995a) (fig. 55). The records from Sarawak, Borneo (Zaidi 1993, Zaidi 1996, Zaidi & Hamid 1996) are based on misidentifications (Zaidi & Ruslan 1995b).

*O. brooksi* can be distinguished from the other medium-sized species of the genus by its long lateral mesonotal fasciae reaching from anterior margin of mesonotum nearly to posterior margin of mesonotum (fig. 51). The shape of the male uncus of *brooksi* (fig. 54) is very characteristic for the species.



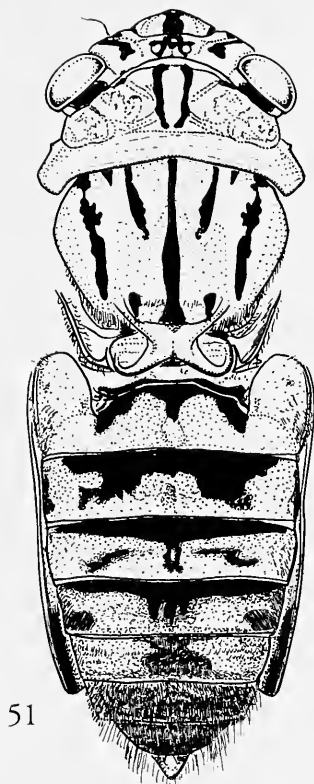
Figs. 42-50. Female opercula of *Orientopsaltria* species in lateroventral view. — 42, *O. padda*, Sabah, 23 km W Sandakan, Sepilok; 43, *O. saudarapadda*, Peninsular Malaysia, Selangor, Bukit Kutu; 44, *O. montivaga*, Sarawak, Gunung Mulu; 45, *O. rustani*, Sumatra, Mt. Bandahara; 46, *O. angustata*, Sarawak, Gunung Mulu; 47, *O. guttigera*, holotype, Singapore; 48, *O. phaeophila*, Sabah, Tawau; 49, *O. maculosa*, Sabah, 65 km W of Lahad Datu, S. Purut camp; 50, *O. ida*, Sabah, Mount Kinabalu.

### Description of the male

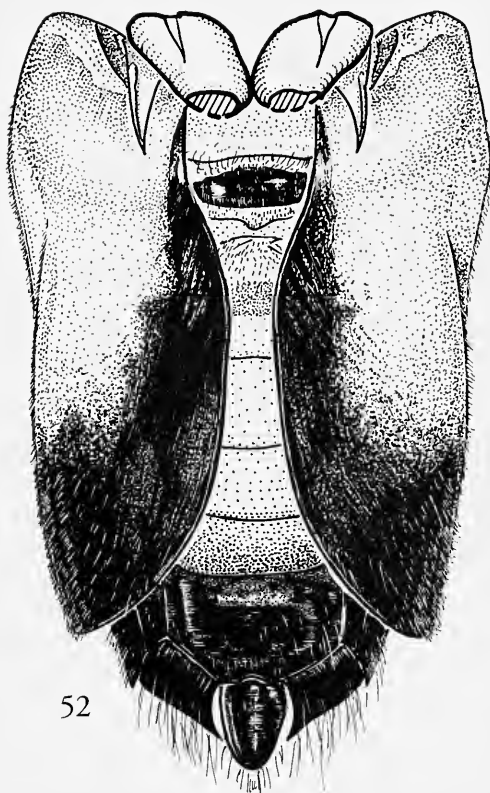
Ground colour brownish, sometimes with a greenish tinge. Marking on head and thorax black.

Head. — Dorsally with large black mark enclosing ocelli, extending distad to frontoclypeal suture, and continuing in a broad, median fascia on the postclypeus. Two narrow lines extend from the paired ocelli proximally to the posterior margin of the head. Median fascia reaching to median oval spot of the

ground colour on the anterior part of the postclypeus. Median oval spot enclosed by broad transverse fascia that slightly narrows from oval spot to lateral sides of postclypeus; in a light-coloured specimen the fascia consists of somewhat fused black lines. Anterior halves of supra-antennal plates with conspicuous black marks, that continue ventrally on the genae in broad black fasciae that slightly widen to the eyes. A pair of fairly broad fasciae running parallel to inner



51



52

Figs. 51, 52. *Orientopsaltria brooksi*, male, Peninsular Malaysia, Pahang, Kuala Rompin. – 51, body in dorsal view; 52, abdomen with opercula in ventral view.

curve of eyes, at a distance to eye equal to fascia width, reach from vertex lobes to almost posterior margin of head. Rostrum with black-brown apex just reaching anterior margin of hind coxae.

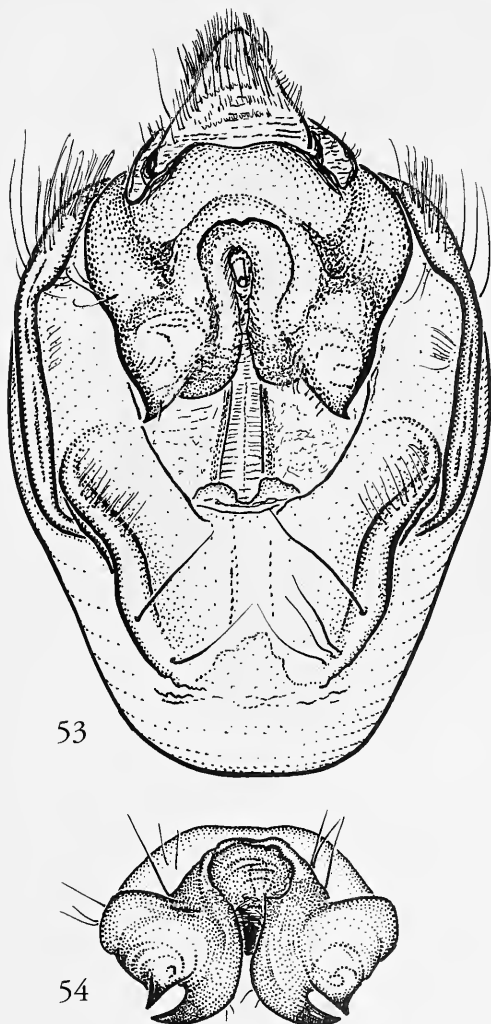
**Thorax.** – Pronotum. Central fasciae fairly narrow, black, and equally wide from anterior pronotal margin to pronotal collar; fasciae proximally slightly widened and converging, but not connected. Posterior oblique fissures sometimes brownish. Posterior margin of pronotum black.

**Mesonotum.** – Five fairly narrow black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation; this fascia gradually widens at about half its length to  $1.5\times$  its anterior width at two fifths of its length from base, and slightly narrows again in front of cruciform elevation. Paramedian fasciae as wide as anterior or posterior part of median fascia, and slightly converging from anterior margin of mesonotum to half-length of mesonotum. Distance between median and paramedian fasciae at most  $4\times$  and at least  $1.5\times$  as wide as paramedian fascia. A pair of small round spots in

front of anterior angles of cruciform elevation. Lateral fasciae very long, reaching from anterior margin of mesonotum to nearly posterior margin of mesonotum,  $1.5\times$  as wide as paramedian fasciae, and half as wide to as wide as distance between paramedian and lateral fasciae. A pair of small black triangles situated at anterior margin of mesonotum between lateral and paramedian fasciae

**Legs.** – Fore femora with subapical dark marks on inner- and outsides, and with a black-brown line connecting the spines along lower edge; hind femora with a broad brown fascia on posterior sides. Fore tibiae distally black-brown, and with a broad black-brown fascia on outside extending along almost whole length of tibia; apical one third of tibiae of middle and hind legs black-brown. Tarsi of fore and middle legs black-brown.

**Tegmina and wings.** – Hyaline with light brownish suffusion; tegmina with basal veins of 2nd and 3rd apical areas infuscated. Venation of tegmen and wing light brown in basal part, turning to dark brown more apically.



Figs. 53, 54. *Orientopsaltria brooksi*, male, Sumatra, Kuala Simpang. – 53, pygofer in ventral view; 54, uncus in antero-ventral view.

Operculum (fig. 52). – Elongate, fairly broad, and reaching to half-length abdominal segment 7. Medial margin evenly convex. Lateral margin weakly convex at base, concave at one third of its length from base, and weakly convex in apical two thirds. Operculum brownish, sometimes with a greenish tinge, in latero-basal part, but often more than half of its surface is black-brown; this black-brown coloration covers the distal one third to more than half of the operculum and extends as a fairly broad fascia along the median margin.

Abdomen. – Anterior margin of segment 2 black,

with a mediodorsal, black triangle reaching to one third or half-length of the segment, and a dark coloration at the medial corners of the tibial coverings. Segments 3-4 with fairly narrow, black-brown fascia along anterior margins, that is often connected with a pair of narrow, transverse, paramedian fasciae, while dark-coloured specimens have a median dark triangle on these segments. In light-coloured specimens segment 5 has a black fascia along anterior margin and a pair of lateral dark marks, while segments 6-7 are somewhat darker medially; in dark-coloured specimens segments 5-7 are dark brown. Ventral side of abdomen proximally light brown and turning to dark brown from segment 4 to the posterior.

Genitalia (figs. 53-54). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with fairly broad and thick to fairly narrow, out-curved ridges. Uncus with large and distinctly globose basal part. Uncus lobes in ventral view broad and equally wide in basal half or two thirds, and gradually tapering laterad to the sharp inwardly curved apex. The medial part of the uncus lobe, which is apically rounded in ventral view, appears to be a medial hook-shaped uncus lobe in proximo-ventral view. Arcuate ridge between uncus lobes over apex of aedeagus fairly strongly elevated and laterally incurved.

Measurements ( $n = 6\delta$ ). – Body length 27.5-30.5 mm; head width 9.5-10.0 mm; pronotum width 9.9-10.5 mm; tegmen length 37.5-40.5 mm.

Material examined. – 8♂. MALAYSIA, PAHANG: Kuala Lompat, 27.viii.1992, Ruslan, Yusof, 1♂ (UKM); 50 km WNW of Kuala Rompin, ca 50 m, 6.x.1961, E. J. Kuncheria, 1♂ (BFBM). – INDONESIA, SUMATRA: Deli, L. P. de Bussy, ex alcohol, 1♂ (ZMA); NE Sumatra, Kuala Simpang, v.1953, A. Sollaart, lowland cult. area, 1♂, same data but: xii.1953, a.l., 2♂, ii.1954, on light, 1♂ (RMNH); Sumatra, 1♂ (NHMW).

### *Orientopsaltria guttigera* group

#### Diagnosis

The *guttigera* group consists of five medium-sized to fairly large species (body length male: 28-35 mm): *O. angustata*, *O. guttigera*, *O. phaeophila*, *O. hol-lowayi*, and *O. maculosa*. One species, *O. guttigera* is restricted to the Malayan Peninsula and Sumatra, three species are Borneo endemics, and *O. phaeophila* is found in Borneo and the Malayan Peninsula. The species of the *guttigera* group have a broad, sometimes indistinct, transverse fascia at half, or two thirds, of the length of the male operculum (figs. 65-68, 87); the only other species of the genus showing this character is *O. palawana* (fig. 89) of the *ida* group. The *guttigera* group is furthermore characterized by a fair-

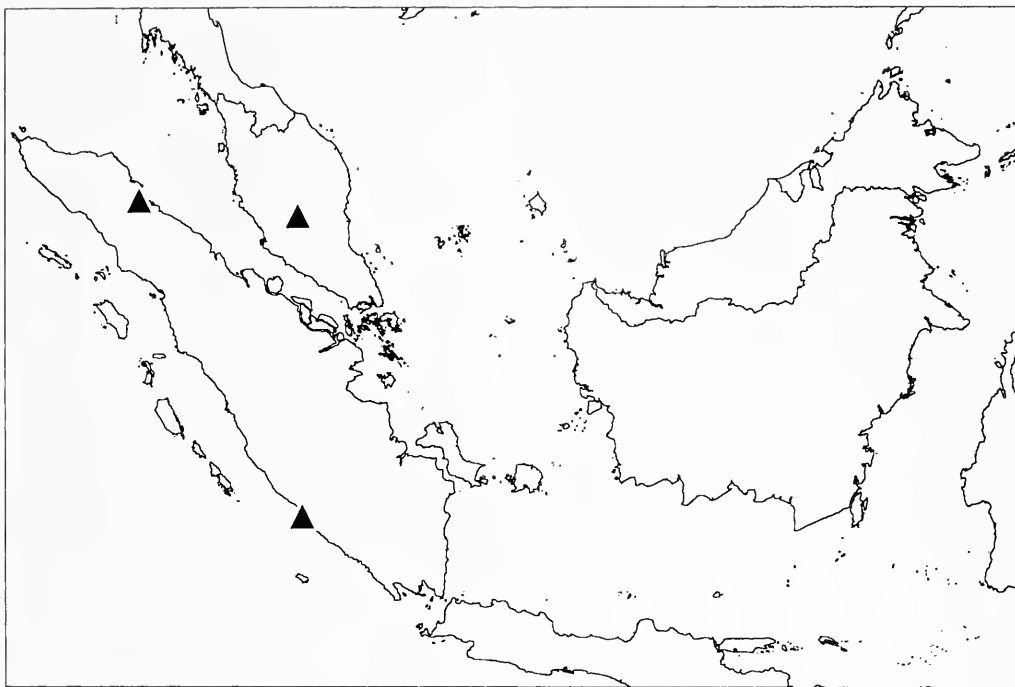


Fig. 55. Distribution of *Orientopsaltria brooksi*.

ly broad uncus with a short, hook-shaped medial spine and an outcurved lateral spine; the latter can be either fairly short and broad or long and strongly narrowed (figs. 60-61, 71, 75-76). The species of this group have brownish infuscations at the bases of the 2nd and 3rd, 5th and 7th apical areas of the tegmen and infuscations at the apices of the longitudinal veins. This character is also found in *O. kinabaluana* and in three species of the *alticola* group.

***Orientopsaltria angustata* sp. n.**

(figs. 46, 56, 58, 60, 62, 65, plate 3: 1)

*Cosmopsaltria guttigera*; Moulton 1923: 88, 94, pl. 2, a, b, 167 (the text only as far as it refers to Sarawak specimens); Singh-Pruthi 1925: 191, pl. 19 fig. 141A-C; Moulton & China 1926: 121, fig. 1e; Moulton 1928: 508.

*Orientopsaltria guttigera*; Duffels 1983: 9; Zaidi 1993: 959, 960; Zaidi & Ruslan 1995b: 197, 198, 200, 201; Zaidi & Ruslan 1995c: 218, 219, 221; Zaidi 1996: 97, 98, 101, 104; Zaidi et al. 1996: 60; Zaidi & Hamid 1996: 49, 50, 53, 56; Zaidi et al. 1996: 60; Zaidi 1997: 113, 114.

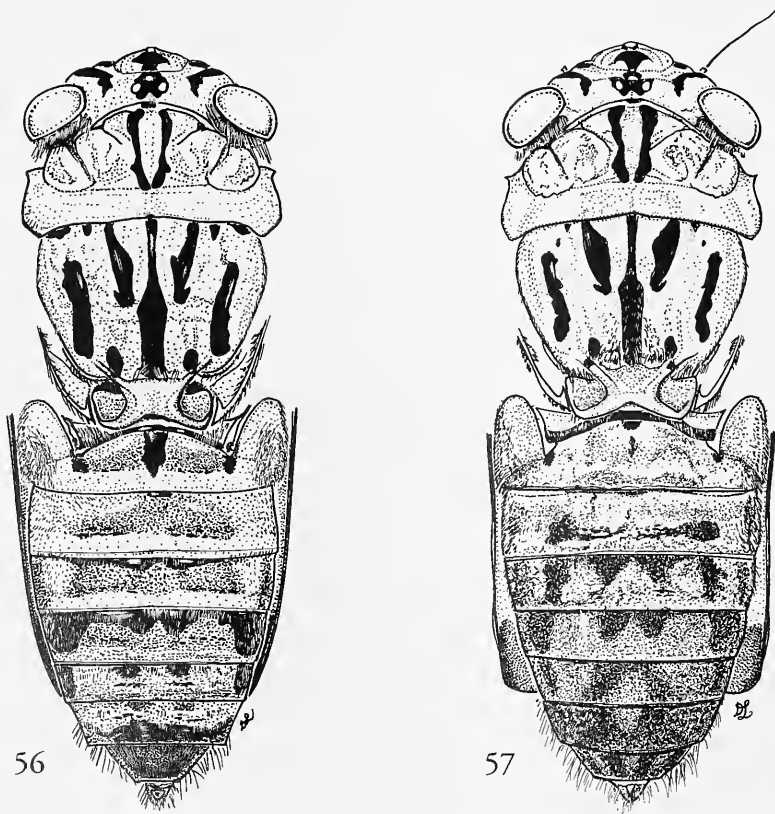
Type material. – 132♂ 9♀. Holotype ♂: 'F. Baczes / 1886 / Borneo' (NHMW). – Paratypes: same data as holotype, 2♂ (NHMW) 1♂ (ZMA); MALAYSIA, SARAWAK: Baram riv. district, 1912, H.W. Smith, 2♂

(MCZ) 1♂ (ZMA); Batu Niah, xii.1980, A. Harman, B.M. 1984-301, 2♂ (BMNH); Bau, ii.11, 1♂, Bau, iv.11, 1♂, Bau, ix.11, 1♂, Bau, vii.11, 2♂, Bau, xii.10, 1♂ (BMNH); Bintulu, 14.viii.1994, Zaidi & Talib, 7♂ (UKM); Bintulu, UPM, 2-3.iii.1992, Zaidi, 4♂, same data but 10.iii.1992, 3♂ (UKM); Bintulu, Pekan, 3.iii.1992, Zaidi, 8♂ (UKM); Bintulu, Taman Hidupan, Liar, 3.iii.1992, Zaidi, 4♂ (UKM); Mt. Dulit, 4000 ft, moss forest, 2.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, T.H. Harrison, 8.0-9.30 P.M., rainy & cold, at light in house, B.M. 1933-254, 2♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 31.viii.1932, light trap 543 mixed13, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 1♂ (BMNH); Julau, Lanjak Entimau, 28-29.ii.92, Zaidi, 43♂ (UKM); Kapit, 9.ii.1987, Duncan Ling, 1♂ (UKM); Gunung Mulu Nat. Park, Site 8, Camp 1, Mulu, 385470, 150 m, mixed dipt. for., February, MV - mainly canopy, J.D. Holloway, RGS Mulu exped., B.M. 1978-206, 3♂ 3♀, same data but: Site 14, Camp 2.5, Mulu, 413461, 1000 m, Lower l. montane forest, February, MV - canopy / understorey, 2♂ (BMNH), Site 20, W. Melinau Gorge, 422577, 150 m, FEG 3, Kerangas, Mar.-Apr., MV - understorey, 1♂ (BMNH); Kedurong, iii.1911, J.C. Moulton, 1911-141, 4♂

(BMNH); Kedurong, J. Moulton 1911, 1♂ (MNP) 1♂ (ZMA); Kedurong Light House, xi.1910, J.C. Moulton, 2♂, same data but ix.1911, 2♂ (MNP); Kedurong Light House, J.C. Moulton (Sarawak Museum), 22.xii.1913, 1♂ (BMNH); Kuching, 8.11, J.M. Bryan, B.M. 1931-150, 1♂ (BMNH); Kuching, ii.1913, J.M. Bryan, 1914-399, 1♂ (BMNH); Kuching, Santubong, 797-1500 m, 18-30.iv.1958, T.C. Maa, 1♂ (BPBM); Limbang, Mendamit, 18-21.ii.1991, Zaidi, 1♂ 5♀ (UKM); Sibü, 1-3.iii.92, Zaidi, 1♂ (UKM); Sarawak, J.M. Bryan, B.M. 1931-150, 1♂ (BMNH); Sarawak, H. W. Smith, 2♂ (MCZ). — INDONESIA, KALIMANTAN: Balikpapan, 1913, v. d. Bergh, coll. Dr. D. MacGillavry, 1♂ (ZMA); Balikpapan, i.1946, R. van Veen, 1♂ (RMNH); Boentok, Barito Riv., G. C. Shortridge, 1910-123, 1♂ (BMNH); Doesonlanden, Wahnes, Brit. Mus. 1962-168, 1♂ (BMNH); 45 km NW of Longiram, S. Mahakam, 21.i.1996, R. Sözer, 1♂ (ZMA); Tiong Buu (= Nahabuan), 18 km NW of Longkay, S. Mahakam, 15.iv.1996, R. Sözer, 1♂ (ZMA); Karimata Island Nat. Ketapang Res., IIS 910039, ii.1991, primary rainforest, closed canopy, 350 m, 108°40'-

109°10'BT 1°25'-1°50' LS, Sutrisno Djenal, 1♀ (ROME); Long Nawang, Mjöberg, 1925, 2♂ (ZMA); Nangka Penuh [=Nangapinoh], 1889, E. Wilmar, 1♂ (RMNH); Poeroek Tjahai [=Puruktjahu], 7.v.1932, Prince Léopold, Reg. Mus. Hist. Nat. Belg. I. G. 9796, 1♂ (KBIN); Pontianak, F. Muir, 1♂ (BPBM); Pontianak, Borneo Exp., Max Weber, 2♂ (RMNH); Samarinda, 8.ii.1929, Prince Léopold, 1♂ (KBIN); Sampit, 19.i.1954, A.H.G. Alston, B.M. 1954-414, at light, 1♂ (BMNH); Sintang, 1884, E. Wilmar, 1884, 1♂ (RMNH); Tandjong, coll. Speyer, 1♂ HNHM.

Study of the material of *O. guttigera* and related species revealed that the specimen from Sarawak described by Moulton (1923) as the male of *C. guttigera* belongs to a new species: *O. angustata*. *O. angustata* is very common in Sarawak and has been found in several localities all over Kalimantan (fig. 62). *O. angustata* vicariates with *O. phaeophila* which is found in the northeastern part of Kalimantan, Brunei and Sabah. The original description of *O. guttigera* was made by Walker (1856) after a female from Singa-



Figs. 56, 57. Male body in dorsal view. — 56, *Orientopsaltria angustata*, holotype, Borneo; 57, *Orientopsaltria guttigera*, Sumatra, 30 km SE of Tanjung Enim.

pore collected by Wallace. The present revision shows that *O. guttigera* occurs in the Malayan Peninsula and Sumatra.

*O. angustata* (fig. 65) can be separated from *O. phaeophila* and *O. guttigera* by its narrow apical two thirds of the male operculum; the apical part is fairly broad in *O. phaeophila* (fig. 67) and *O. guttigera* (fig. 66) (see also the discussion under *phaeophila*). *O. angustata* (fig. 56), *O. phaeophila* (fig. 69), and *O. guttigera* (fig. 57) can easily be separated from *O. brooksi* (fig. 51), an endemic species from Sumatra of about the same size, by the lateral mesonotal fasciae that do not reach the anterior margin of the mesonotum.

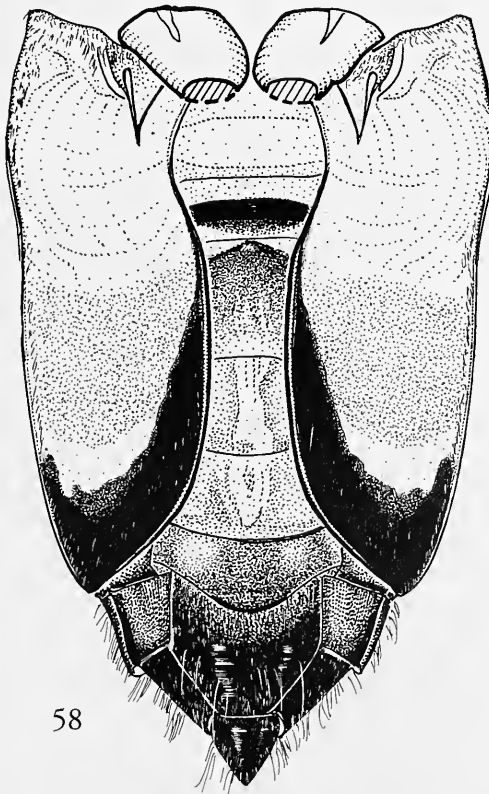
### Description

Ground colour brownish, sometimes with greenish tinge. Marking on head and thorax black.

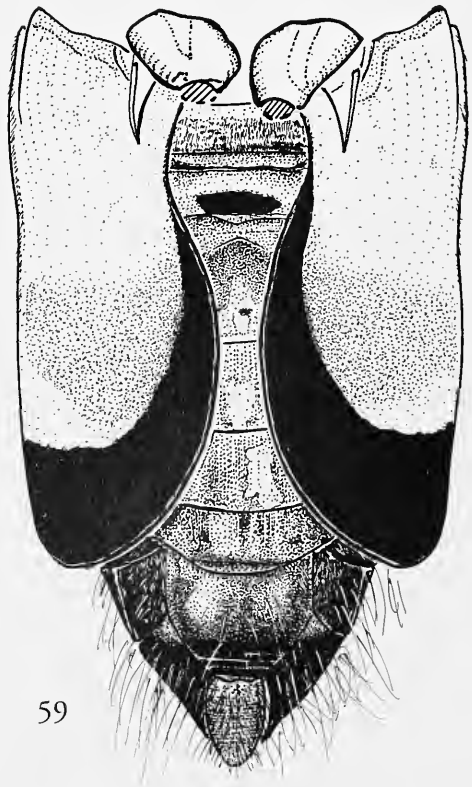
Head. – Dorsally with large black mark that encloses the ocelli, narrows distad toward frontoclypeal suture, and continues on postclypeus in an often an-

chor shaped or lanceolate spot extending distad to a line enclosing a median oval spot of the ground colour on anterior part of postclypeus; median mark narrowing proximad and reaching anterior margin of pronotum in 90% of the specimens. Supra-antennal plates with a black triangle. A pair of fairly broad fasciae running parallel to inner curve of the eyes, at a distance to the eye equal to fascia width, reach the vertex lobes but not the posterior margin of the head. Anterior part of postclypeus with 4-5 (7) transverse lines on either side, median ends of these lines connected by a line enclosing an oval spot of the ground colour; upper pair of lines reaching to supra-antennal plates, the lower lines become gradually shorter. Ventral side of postclypeus with narrow median line reaching from ground coloured oval spot to clypeal suture; this line is missing in 10% of the specimens. Rostrum dark brown to black apically, and just not reaching posterior margin of hind coxae.

Thorax. – Pronotum. Paired central fasciae about



58



59

Figs. 58, 59. Male abdomen with opercula in ventral view. – 58, *Orientopsaltria angustata*, holotype, Borneo; 59, *Orientopsaltria guttigera*, Sumatra, 30 km SE of Tanjung Enim.

equally wide from anterior pronotal margin to pronotal collar, fasciae anteriorly slightly converging but not connected, posteriorly more strongly converging and connected in middle of anterior margin of pronotal collar. Posterior margin of pronotal collar with very narrow, black line.

**Mesonotum.** – Five black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation; fascia anteriorly very narrow, at half-length of mesonotum strongly widened to more than  $5\times$  its anterior width and posteriorly slightly narrowed. Paramedian fasciae extending from anterior margin to about half-length of mesonotum; fasciae anteriorly  $1.3\times$  and at half their length  $3.6\times$  as wide as anterior part of median fascia, and slightly narrowed to the posterior end, which is often apically recurved; greatest width of paramedian fascia about as wide as shortest distance between median and paramedian fasciae. A pair of small round spots in front of anterior angles of cruciform elevation. Lateral fasciae reach from one third or one fourth of mesonotum length to nearly posterior margin of mesonotum and are one third to three fourths as wide as distance between paramedian and lateral fasciae. Some specimens with pair of very small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae.

**Legs.** – Fore femora with subapical brown marks on inner- and outside and a black-brown line connecting the spines along lower edge; hind femora with broad, dark brown, fasciae on upper and posterior sides. Fore tibiae with about distal half of outside and distal one sixth of innerside black-brown; middle tibiae with distal one fourth to one third black-brown; hind tibiae proximally and on distal half black-brown to brown. Tarsi of fore and middle legs dark brown to black.

**Tegmina and wings.** – Hyaline with yellowish brown suffusion. Tegmina with basal veins of 2nd and 3rd apical areas distinctly infuscated, and those of 5th and 7th apical areas somewhat lighter to very weakly infuscated; apices of longitudinal veins weakly infuscated. Venation light to dark brown.

## Male

**Operculum** (figs. 58, 65). – Elongate and fairly narrow, reaching to half-length abdominal segment 6 or to half-length segment 7. Medial margin weakly convex. Lateral margin very slightly convex in basal third, very weakly concave at one third or one fourth of its length from base, and straight along apical two thirds up to rounded apex. Rim along whole operculum margin dark brown to black. Black coloration along medial margin widening from one third of length from base to black coloured apical one fourth or one fifth of operculum. A vague transverse area, about one fourth as high as operculum length, some-

what darker than the ground colour, is situated at two thirds of operculum length in most specimens.

**Abdomen.** – Segment 2 with mediodorsal, dark brown to black, obconical spot at anterior margin. Segments 2-3 dorsally with pair of paramedian, transverse, rectangular, red-brown to dark brown marks; marks on segment 2 extending laterally to medial corners of timbal coverings; marks on segment 3 as wide as on segment 2. Segments 4-6 with bicuspidate mediodorsal mark, about half as high as segment length, and irregular lateral spots. Marking on segments 2-4 and 5-6 restricted to respectively anterior two thirds and anterior four fifths of segment. Posterior margins of segments 2-5 often lighter coloured. Dorsal sides of segments 2-6 often with vague marking, or darkened so that the pattern is hardly or only partly distinguishable. Segments 7-8 darker brown without marking. Ventral side of abdomen proximally light brown and turning dark brown distally.

**Genitalia** (fig. 60). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with narrow regularly outcurved ridges. Uncus with large and distinctly globose basal part. Uncus lobe with strongly narrowing outcurved lateral spine, and with a shorter hook-shaped medial spine; lateral margin basally weakly convex, and concave at half-length to the lateral spine. Arcuate ridge over narrow gap between uncus lobes strongly elevated and outcurved.

## Female

**Operculum** (fig. 46). – Ochraceous, reaching to just beyond anterior margin or to one third of length of abdominal segment 3; lateral margin with basal half undulate, and apical half oblique, straight and dark brown coloured to the obtuse laterodistal angle; distal margin weakly convex but strongly convex toward the meracanthus.

**Abdomen.** – Dorsally with anterior two thirds of segments 2-7 slightly or distinctly darker brown than posterior one third of these segments, with a pair of faint fairly small central spots at anterior margins of segments 4-8, a pair of small paramedian spots on segments 4-5, a pair of small lateral spots on segments 6-8, and with a pair of indistinct, triangular dark marks at anterior margin of segment 9. Dorsal side of abdomen covered with scattered silvery pilosity especially on lateral parts of the segments. Ventral side of abdomen brown with black-brown coloration along posterior margins of sternites and along distal parts of lower margins of segment 9, and with a fairly broad dark brown medial fascia on sternite 7.

**Measurements** (body length  $\delta$   $n=20$ ; other measurements  $n=6\delta$   $6\varphi$ ). – Body length  $\delta$  30.5-35 (32.6 $\pm$ 1.1) mm,  $\varphi$  29.5-30.5 mm; head width  $\delta$  10.5-11.2 mm,  $\varphi$  10.6-11.1 mm; pronotum width

♂ 10.9-12.4 mm, ♀ 11.3-11.7 mm; tegmen length  
♂ 43.5-46 mm, ♀ 42.5-44 mm.

***Orientopsaltria guttigera*** (Walker, 1856)  
(figs. 47, 57, 59, 61, 62, 66, plate 3: 2)

*Dundubia guttigera* Walker, 1856: 83, Holotype ♀: 'Wallace Sing' (Wallace: printed; Sing: handwritten), '*guttigera n.s.*' (handwritten), 'Type' (print within green circle) (BMNH) [examined].

*Dundubia guttigera*; Dohrn 1859: 73; Atkinson 1886: 186; Distant 1892b: 153.

*Cosmopsaltria guttigera*; Moulton 1923: 88, 94, 167 (as far as the text refers to the type specimen from Singapore and a specimen from Sumatra); Singh-Pruthi 1925: 191, pl. 19 fig. 141A-C; Mercalf 1963: 548; Duffels & Van der Laan 1985: 135.

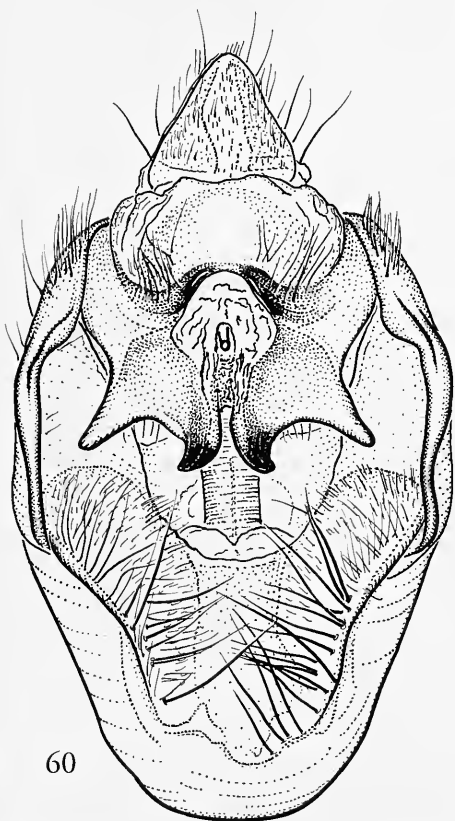
*Orientopsaltria guttigera*; Duffels 1983: 9; Zaidi et al. 1996: 60; Duffels & Zaidi 1998: 321.

[Misidentification: *Cosmopsaltria* sp. aff. *guttigera* Endo & Hayashi 1979: 37, figs. 10-12.]

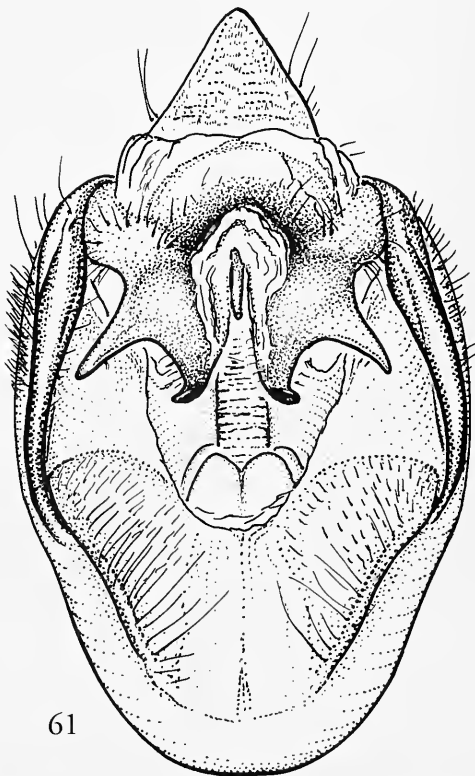
[The publications referring to *guttigera* but in fact dealing with *angustata* are listed under the latter species.]

*O. guttigera* is considerably smaller (body length male: 27.7-30.6 (29.1±1.0) mm) than *O. angustata* (30.5-35 (32.6±1.1) mm) and *O. phaeophila* (28.9-33.5 (31.4±1.3) mm).

*O. guttigera* is found in Sumatra and the Malayan Peninsula (fig. 62). *O. guttigera* can be distinguished from *O. phaeophila* by the wider anterior part of the lateral mesonotal fascia, viz., in *guttigera* (fig. 57) as wide as to one third as wide, as the distance between paramedian and lateral fasciae, and in *phaeophila* (fig. 69) one third to one sixth as wide. *O. guttigera* and *O. phaeophila* can easily be distinguished from *O. angustata* by the apical part of the male operculum, that is fairly broad in *guttigera* and *phaeophila*, and narrow in *O. angustata*. *O. guttigera* cannot be separated from *O. angustata* and *O. phaeophila* by the shape of the uncus or other features of the male genitalia. The male genitalia of *O. guttigera* (fig. 61) and *O. angustata* (fig. 60) and *O. phaeophila* (fig. 71) do not provide reliable characters for separating the species.



60



61

Figs. 60, 61. Male pygofer in ventral view. – 60, *Orientopsaltria angustata*, paratype, Malaysia, Sarawak, Bau; 61, *Orientopsaltria guttigera*, Sumatra, 30 km SE of Tanjung Enim.

### Identity

The female holotype of *O. guttigera* is a little peculiar: the right tegmen has nine apical cells, and both tegmina have one extra, triangular cell between the apical parts of respectively the second and third ulnar cells (left tegmen) and the third and fourth ulnar cells (right tegmen).

Distant (1892b) could not find Walker's type-specimen, and ignored *guttigera* in his later publications. Moulton (1923) rediscovered the female type of *guttigera* in the BMNH, and described the male of *guttigera* for the first time from Sarawak. The present revision shows that Sarawak specimens identified as *guttigera* belong to *O. angustata*. Moulton (1923) also recorded a small male specimen of *guttigera* from Medan, Sumatra, that differed from the Sarawak specimens in various characters. The characters of the Medan specimen listed by Moulton perfectly fit the specimens from Sumatra and the Malayan Peninsula attributed here to *guttigera*.

### Description

Ground colour brownish, often with greenish tinge. Marking on head and thorax as in *O. angustata*, with exception of the following features. The large

black mark enclosing the ocelli extends to the anterior margin of pronotum in 50% of the specimens (in *angustata* in 90% of the specimens). The distance between the eye and the curved fascia running parallel to inner curve of the eye is about twice as wide as fascia (in *angustata* equally wide). A median, short or somewhat longer, line on the ventral side of post-clypeus is found in several specimens.

Thorax. – Pronotum as in *angustata*.

Mesonotum. – As in *angustata* but the paramedian fasciae anteriorly as wide as anterior part of median fascia (in *angustata* 1-3× as wide). In both species the paramedian fasciae widen considerably, at half-length of the fascia, to 3-6× their anterior width. The lateral fasciae are as wide to one third as wide as distance between paramedian and lateral fasciae (in *O. angustata* three fourths to one third as wide).

Legs. – The subapical marks on the inner- and outer-sides of the fore femora found in *O. angustata* are lightly coloured or missing.

Tegmina and wings. – As in *angustata*, but tegmina with basal veins of 2nd and 3rd apical areas distinctly infuscated, and apices of longitudinal veins weakly infuscated, but the basal veins of the 5th and 7th apical areas are always very weakly infuscated.

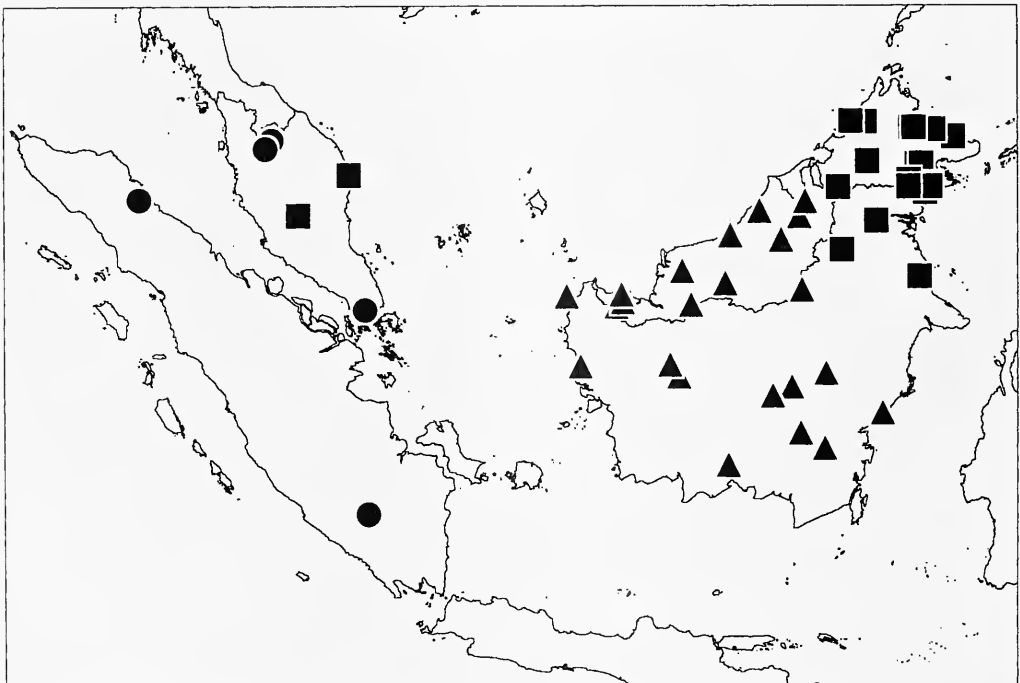
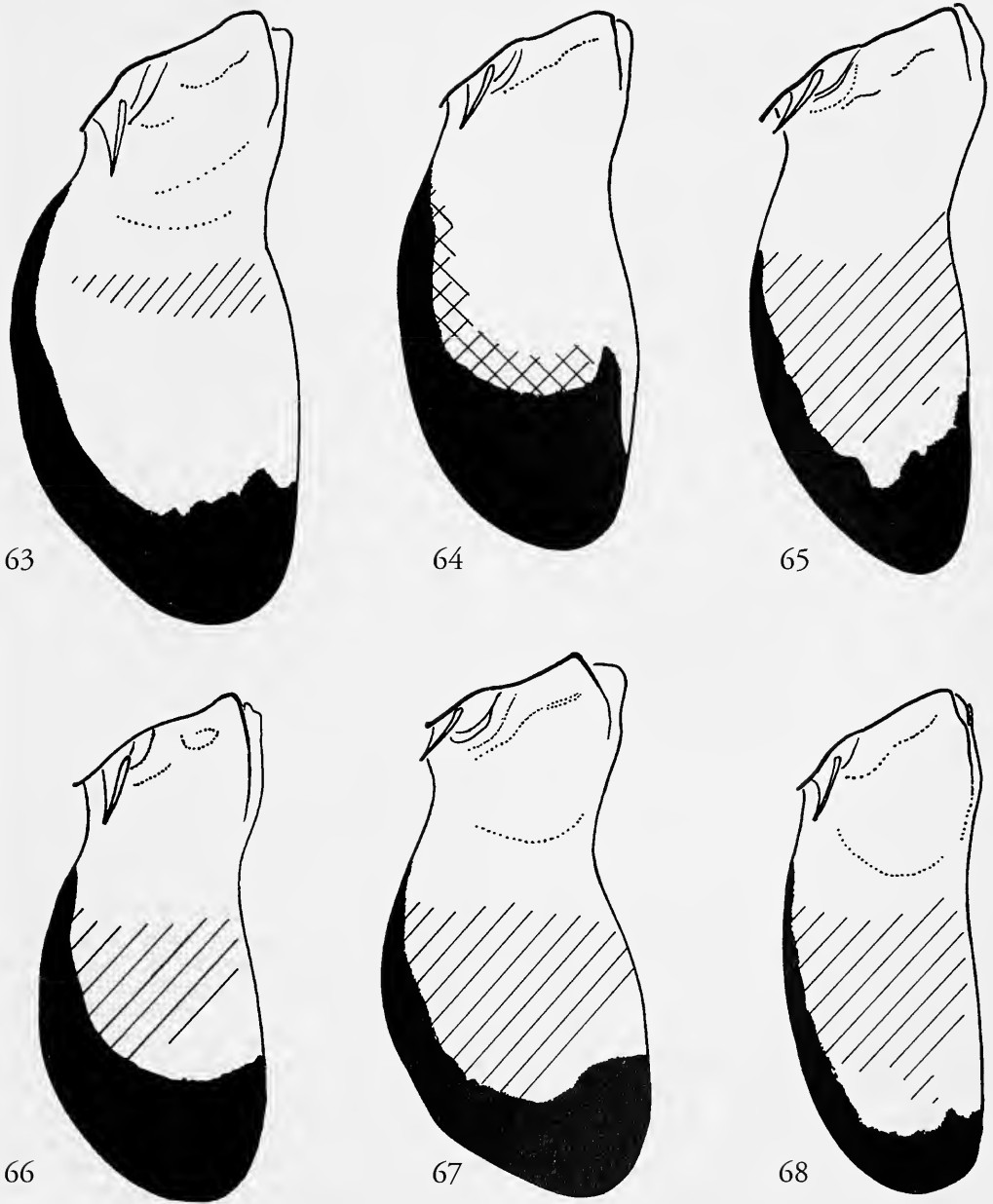


Fig. 62. Distribution of *Orientopsaltria angustata* (triangles), *O. guttigera* (rounds), and *O. phaeophila* (squares).



Figs. 63-68. Male opercula of *Orientopsaltria* species in lateroventral view. — 63, *O. agatha*, Sabah, Danum Valley, Krikken and Rombaut; 64, *O. brooksi*, Peninsular Malaysia, Pahang, Kuala Rompin; 65, *O. angustata*, paratype, Sarawak, Bau; 66, *O. guttigera*, Sumatra, 30 km SE of Tanjung Enim; 67, *O. phaeophila*, Sabah, Danum Valley, junction Sg Segama and Sg Palum Tambun, bridge of Segama; 68, *O. maculosa*, paratype, 65 km W of Lahad Datu, S. Purut camp.

## Male

Operculum (figs. 59, 66). – Elongate and fairly broad, slightly outcurved, and reaching to half-length abdominal segment 6 or to half-length segment 7. Medial margin evenly and strongly convex. Lateral margin convex in basal third, distinctly concave at one third or one fourth of its length from base, and weakly convex to the broadly rounded apex. Rim along whole operculum margin dark brown to black. Black coloration along medial margin widening from one fifth of length from base to black coloured apical one third or one fourth of operculum. Some specimens have a vague transverse area at half or two thirds of operculum length which is somewhat darker than the ground colour.

Abdomen. – Segment 2 with mediodorsal, dark brown to black, obconical spot or triangle at anterior margin. Segment 3, and sometimes segment 2, dorsally with pair of paramedian, transverse, sometimes rectangular, dark brown to black-brown marks, which are 1.5 to 2× as wide as long. Segments 4–6 with bicuspidate mediodorsal mark, about half as high as segment length (fig. 57), and irregular lateral spots, but some specimens have conspicuous transverse, rectangular marks on anterior two thirds of these segments. Posterior margins of segments 2–6 often lightly coloured. Segments 7–8 light or dark-coloured, sometimes with indistinct paramedian marks. Ventral side of abdomen proximally light brown and turning dark brown distally.

Genitalia (fig. 61). – As in *angustata*.

## Female

Operculum (fig. 47). – As in *angustata*.

Abdomen brownish.

Measurements (n = 8♂ 1♀). – Body length ♂ 27.7–30.6 (29.1±1.0) mm, ♀ 26 mm; head width ♂ 9.3–10.2 mm, ♀ 9.5 mm; pronotum width ♂ 9.5–10.8 mm, ♀ 10.0 mm; tegmen length ♂ 37–41 mm, ♀ 39.5 mm.

Material examined. – 14♂. INDONESIA, SUMATRA: Banko, 30 km SE of Tanjung Enim, 3°48'S 103°55'E, 20.iv.1978, Murray Radestock, 1♂ (Moulds); T. Enim, 24.iii.1978, 1♂ (Moulds); Deli, L. P. de Bussy, ex alcohol, 4♂ (ZMA); Kuala Simpang, iii.1954, A. Sollaat, lowland cultiv. area, a.l., 1♂ (RMNH); Seleleh, Kuala Simpang, lowland forest, iii.1954, A. Sollaat, 1♂ (RMNH). – MALAYSIA: PENINSULAR MALAYSIA: KELANTAN: Lata Rek, 22.vi.1996, Ismail & Muzamil, 1♂ (UKM); KEDAH: Temenggor, Ekspedisi MNS - Belum, 4–10.iv.1994, Zaidi, Ruslan, Jasmi, 1♂ (UKM); OTHER LOCALITIES: Malacca, Plason, 1890, 3♂ (NHMW) 1♂ (ZMA).

*Orientosaltria phaeophila* (Walker, 1850)  
(figs. 48, 62, 67, 69–71, plate 3: 3)

*Dundubia phaeophila* Walker, 1850: 52. Lectotype ♂ (here designated): 'Corea' (handwritten) and on the rear '47

21' (handwritten), 'phaeophila Wlk' (handwritten), 'Type' (printed on round label with green circle) (BMNH) [examined].

*Dundubia phaeophila*; Walker 1857: 141; Dohrn 1859: 72; Moulton 1911a: 123.

*Dundubia phaeophila* (sic); Walker 1858: 6 (equals *D. dorei*).

*Cosmopsaltria phaeophila*; Distant 1890: 68; Distant 1892a: pl. 12, figs. 21, a, b; Distant 1892b: xii; Distant 1906: 56; Oshanin 1906: 3; Kirkaldy 1907: 306; Oshanin 1908: 387; Moulton 1911a: 140, 155; Moulton 1911b: 186; Oshanin 1912: 94; Distant 1912: 44; Moulton 1923: 94 (partim: Corea; records from Borneo in syn. of *guttigera*); Kato 1925a: 42, 46; Moulton & China 1926: 121; Kato 1927: 27; Kato 1931: 45, 64; Kato 1932: 165, 200, 217, 324, fig. 116; Metcalf 1963: 553, 554; Nast 1972: 141; Duffels & Van der Laan 1985: 136; Lee 1995: 130, 138; Lee, 1999: 12.

*Orientosaltria phaeophila*; Duffels 1983: 10; Zaidi & Ruslan 1995a: 64, 68; Zaidi & Ruslan 1995b: 197, 198, 200, 201, 203; Zaidi et al. 1996: 60; Duffels & Zaidi 1998: 321.

Moulton (1923, Moulton & China 1926) already believed that *phaeophila* was incorrectly recorded from Korea. The files of the BMNH provide the following information for the lectotype acquisition label 47 21: '32 Hemiptera Homoptera', 'Corea, Presented by Capt. Sir E. Belcher, collected by Arthur Adams Esq during the voyage of the H.M.S. Samarang', but there is enough evidence to conclude that *phaeophila* does not occur in Korea (Lee 1995, 1999). Two other species, *Dundubia serva* and *Fidicina aquila*, which were also described by Walker (1850) from Korea, do not occur in Korea either (Lee 1995); both are probably Sundaland species. The types of the latter two species bear the same round label 'Corea' and the acquisition number '47 21' as the *Dundubia phaeophila* types.

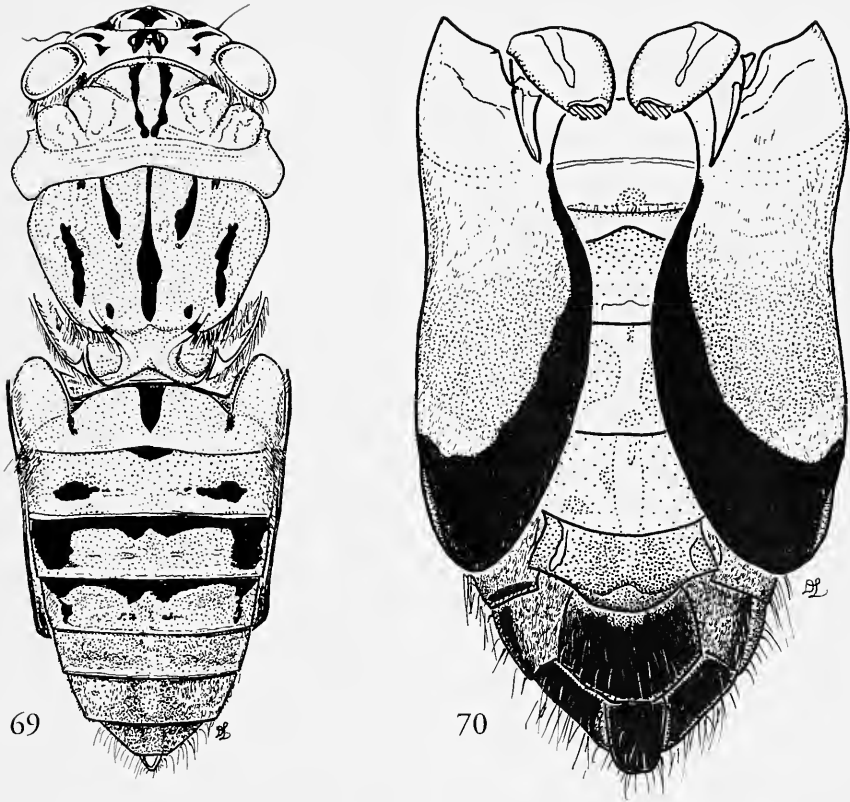
*O. phaeophila* is known from the northern part of Borneo: Sabah, Brunei and Northeast Kalimantan (fig. 62); the species is not known from Sarawak, and only recently recorded from Peninsular Malaysia (Zaidi & Ruslan 1995, Zaidi et al. 1996). The distributions of this species and *O. angustata* seem to vicariate in Borneo.

## Identity

Moulton repeatedly stated (Moulton 1923, Moulton & China 1926) that the type specimens of *phaeophila* differ from *guttigera* in several features, but that *phaeophila* may prove to be synonymous with *guttigera*. Our study of a large material of *phaeophila* and *guttigera*, collected over the last decades, shows that *phaeophila* and *guttigera* are distinct species. The types of *phaeophila* perfectly agree with a large material from northern Borneo identified here as *phaeophila*.

## Description

*O. phaeophila* can be separated from *O. angustata* by a combination of characters: the width of the mesonotum lines, the marking on the head and the



Figs. 69, 70. *Orientopsaltria phaeophila*, male. – 69, body in dorsal view, Kalimantan, Boeloengan; 70, abdomen with opercula in ventral view, male, Sabah, Danum Valley, junction Sg Segama and Sg Palum Tambun, bridge of Segama.

shape of the male operculum. The anterior part of the lateral mesonotal fasciae is one third to one sixth as wide as distance between paramedian and lateral fasciae in *phaeophila* (fig. 69), and three fourths to one third as wide in *angustata* (fig. 56). The median black spot on the vertex around the ocelli does not extend to the pronotum in 90% of the material of *phaeophila*, and does extend to the anterior margin of the pronotum in 90% of the material of *angustata*. Most specimens of *angustata* have a narrow brown to black line on the postclypeus reaching from ground coloured oval spot to clypeal suture, while this line is often missing or very short in *phaeophila*. The most reliable character for distinguishing the two species is the shape of the male operculum. The apical two thirds of the operculum of *phaeophila* (fig. 67) is broad with a distinctly convex lateral margin, while the apical two thirds of the operculum of *angustata* (fig. 65) is narrow with a characteristic straight lateral margin. The opercula of both species are dark brown

to black-brown along the median and apical margins. *O. phaeophila* has a distinct, fairly broad, transverse brown fascia on the operculum with the narrow area between the fascia and the brown margin often yellowish, while this fascia is mostly absent or broad and vague in *O. angustata*. The shape of the uncus and other features of the male genitalia do not provide reliable characters to separate *O. phaeophila* from *O. angustata* and *O. guttigera*; the uncus is variable in shape in all three species. In the female operculum and abdomen *O. phaeophila* is very much alike to *O. angustata*, though the marking of spots on the abdomen is much less distinct than in *O. angustata*.

Measurements (body length ♂  $n=20$ ; other measurements  $n=6\text{♂ } 6\text{♀}$ ). – Body length ♂ 28.9–33.5 (31.4 $\pm$ 1.3) mm, ♀ 25.2–32.1 mm; head width ♂ 9.9–11.2 mm, ♀ 9.6–11.0 mm; pronotum width ♂ 10.2–12.0 mm, ♀ 10.0–11.6 mm; tegmen length ♂ 39.5–45 mm, ♀ 39–44 mm.

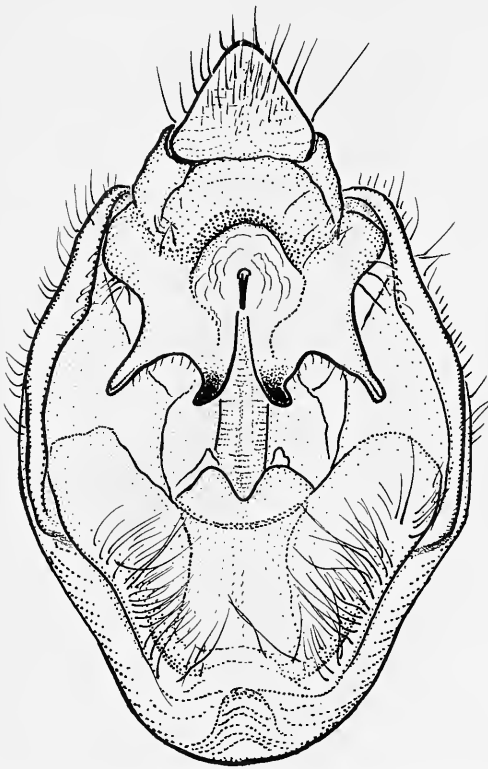


Fig. 71. *Orientopsaltria phaeophila*, male pygofer in ventral view, Sabah, Danum Valley, 70 km W Lahad Datu, Field Centre.

Material examined. – 216♂ 93♀. MALAYSIA: PENINSULAR MALAYSIA: PAHANG: Kuala Lompat, 25-27.viii.90, Ismail & Zabidi, 1♂ (UKM); Kuala Lompat, 27.viii.1992, Ruslan, 2♂ 1♀ (UKM); Lancang, Bukit Rengit, 24-27.i.1992, Zaidi, Ismail & Zabidi, 1♂ (UKM); Rompin Endau, 23.vii.1992, Badrul & Haji, 1♀ (UKM). – SABAH: 105 km S of Beaufort, Long Pa Sia area, confluence Sg Pa sia - Matang, 4°24'N 115°43'E, 1000 m, 1.iv.1987, semicultivated area near disturbed evergr. tropical rainforest, at light, J. van Tol & J. Huisman, 2♂ (RMNH); Lembah Danum, 14.iii.1994, John, 3♂, same data but 2.ii.1994, 2♂ 4♀, 29.iii.1994, 2♀, 17.iv.1994, 3♂ (UKM); Lembah Danum, 4-7.xii.1990, Zaidi, Ismail, Ruslan, 6♂ 2♀, same locality but 3-5.xii.1991, Zaidi, Is, Lan, Yus, 2♂ 1♀, 15-20.v.1991, Zaidi, Ismail, Ruslan, 5♂, 25-30.viii.1991, M.S., Zaidi, Mail, Lan, 4♂ 2♀, 22-26.viii.1992, Ismail, Shan & Yusof, 9♂ 2♀, 16.ix.1995, Zaidi, 3♂ (UKM); Danum Valley, 5°01'N 117°47'E, 220 m, 10.ix.1987, light trap sample, roadside, secondary forest, NMW Sabah (Borneo) Expedition, NMW.Z.1987.094, A.H. Kirk-Spriggs, 3♂, same data but: 150 m, 26.ix.1987, 2♂ 1♀, 120 m, 17.x.1987, lowland mixed dipterocarp forest, light trap sample primary forest edge, 2♂ (NMW); Danum Valley, 70 km W Lahad Datu, Field Centre, 150 m, 28.xi.1989, sample Sab. 45, at light, M.J. & J.P. Duffels, 1♂, same data but: 29.11-5.xii.1989,

sample Sab. 48, 4♂ 2♀, 10-17.xii.1989, sample Sab. 63, 2♂ 1♀ (ZMA); Danum Valley, 70 km W Lahad Datu, Sungai Segama, W side suspension bridge, 150 m, 29.xi.1989, sample Sab. 47, understorey secondary growth/canopy riverine rainforest, at light, M.J. & J.P. Duffels, 7♂ 10♀, same data but: 30.xi.1989, sample Sab. 49, 2♂ 3♀ (ZMA); Danum Valley, 70 km W Lahad Datu, Next to bridge nature trail, 150 m, 1.xii.1989, sample Sab. 50, rainforest along narrow stream, at light, M.J. & J.P. Duffels, 2♂ (ZMA); Danum Valley, 70 km W Lahad Datu, Field Centre, nr. Main Trail East, 150 m, 3.xii.1989, sample Sab. 55, primary forest margin along road, at light, M.J. & J.P. Duffels, 1♂ 1♀ (ZMA); Danum Valley, 70 km W Lahad Datu, Field Centre, Main Trail West 0 North 5, 150 m, 16.xii.1989, sample Sab. 71, secondary vegetation/canopy/primary forest margin, at light, M.J. & J.P. Duffels, 2♂ 1♀, same data but Sab. 67, 14.xii.1989, 1♂, 15.xii.1989, 1♂ (ZMA); 60 km W of Lahad Datu, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun, bridge of Segama, 4°58'N 117°48'E, 150 m, 20.iii.1987, at light, 18.20-21.00, clearing, edge of untouched evergr. lowl. rainforest, leg. Van Tol & Huisman, 3♂ 1♀, same data but: 19.iii.1987, 2♂ 1♀, 26.iii.1987, 2♂ (RMNH); 60 km W of Lahad Datu, Danum Valley Field Centre, at junction Sg Segama and Sg Palum Tambun, bridge of Palum Tambun, 4°58'N 117°48'E, 150 m, 23.iii.1987, at light, 18.30-21.00, edge of untouched evergr. lowl. rainforest, leg. Van Tol & Huisman, 3♂ (RMNH); 60 km W of Lahad Datu, Danum Valley Field Centre, at junction Sg Segama and Sg Palum, road DVFC-kil Silam nr. km 68.5, 4°58'N 117°48'E, 150 m, 24.iii.1987, at light, 18.30-21.00, disturbed evergr. lowland rainforest, leg. Van Tol & Huisman, 1♂ (RMNH); 60 km W of Lahad Datu, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun, 4°58'N 117°48'E, 150 m, at light, brooklet above Lotus pond, 25.iii.1987, 18.30-21.00, untouched evergr. lowl. rainforest, leg. Van Tol & Huisman, 1♂ 1♀ (RMNH); Danum Valley, Danum Valley Field Centre, 100-200 m, 18-29.x.1987, multistr. evergr. forest along river, at light, Krikken & Rombaut, 4♂ 3♀ (RMNH); 75 km W Lahad Datu, confl. S. Sabran, S. Danum, S/N, 117°41'E 4°57'N, 200 m, 25.x.1987, J. Huisman & R. de Jong, 3♂ 2♀ (RMNH); 60 km W of Lahad Datu, DVFC, E0, Sg. Segama, 4°58'N 117°48'E, 150 m, 18.x.1987, J. Huisman & R. de Jong, ML-light, 1♀ (RMNH); 60 km W of Lahad Datu, DVFC, nr Segama bridge, 4°58'N 117°48'E, 150 m, 20.x.1987, J. Huisman & R. de Jong, 2♂ 1♀ (RMNH); 60 km W of Lahad Datu, Danum Valley Field Centre at junction Sg Segama and Sg Palum 65 km W Lahad Datu, S. Purut camp, 117°45' E 4° 57'N, 200 m, 26.x.1987, ML-light, J. Huisman & R. de Jong, 1♂ 2♀ (RMNH); Kalabakan, 10-19.xi.1958, L.W. Quate, Light Trap, 2♂ (BPBM); Kalabakan, Tawau Residency, 14-15.xi.1958, L.W. Quate & T.C. Maa collectors, M.V. light trap, 6♂ (BPBM); 19 km N of Kalabakan, Forest Camp, 19.x.1962, K.J. Kuncheria collector Bishop, 1♂, same data but: 25.x.1962, 1♂, 30.x.1962, 4♂, same data but: 60 m, 27.x.1962, 5♂ (BPBM); N of Kalabakan, Tawau, 200', 19.x.1962, K.J. Kuncheria collector Bishop, Light trap, 1♂ (BPBM); 19 km N of Kalabakan, Forest Camp, 20.x.1962, Primary forest, Y. Hirashima, 2♂, same locality, 25.x.1962, Light trap, Y. Hirashima, 1♂, 25.x.1962, 1♂ (BPBM); Gunung Kinabalu, Sayap, 9.v.1992, Zaidi, Nordin, 1♂, same locality, 3-8.vi.1992, Zaidi, Ismail, Ruslan, 1♂ (UKM); Kinabatangan, Batu Putih, 6-15.iv.1994, Nordin Wahid, 1♂ 1♀ (UKM); 7 km S Nabawan, nr. old airstrip, 116°27' E

5°02' N, 14.xi.1987, 400 m, J. Huisman & R. de Jong, at light, 1♂ (RMNH); 12.5 km S Nabawan, Kg. Pamuntaria, nr. river, 116°27' E 5°02' N, 16.xi.1987, 400 m, J. Huisman & R. de Jong, ML-light, 1♀ (RMNH); Sabah, Pulau Gaya, 26-30.ix.1991, Zaidi, S. Abin, 1♂ 1♀ (UKM); 60 km W Sandakan, Sungai Darling, 26.xi.1989, sample Sab. 43, secondary forest understorey, at light, M.J. & J.P. Duffels, 2♂ (ZMA); Sepilok, 13-28.i.1974, J.C. Quentin, foret primaire, 1♂ 1♀ (MNP); Sepilok, 5-11.viii.1983, N. Ohbayashi leg., Natn. Sci. Mus. Tokyo: Loan No. He-97-012, 1♀, same data but Loan No. He-97-011, 1♂ (NSMT); Tawau, Cocoa Res. Station, 28.viii.1962, Y. Hirashima, Light trap, 2♂ 1♀ (BPBM); Tawau, Quoin Hill, Cocoa Res. Sta., 7-12.viii.1962, Y. Hirashima, 1♂, same data but: 22.viii.1962, 2♀, 19.ix.1962, 2♂, 20.ix.1962, 1♀ (BPBM); Tawau, Quoin Hill, Cocoa Res. Sta., 225 m, 24.ix.1962, Y. Hirashima, Malaise trap, 4♂ 4♀, same data but 20.ix.1962, 3♂, 23.ix.1962, 4♂ 4♀, 24.ix.1962, 1♂, 25.ix.1962, 1♀, 27.ix.1962, 4♂, 1.x.1962, 2♂ 1♀, 26.vii.1962, Light trap, 1♂, 1.viii.1962, Light trap, 7♂ 6♀ (BPBM); Tawau, Quoin Hill, Cocoa Res. Sta., 225 m, 20.ix.1962, K.J. Kuncheria, 2♀ (BPBM); Tawau, Quoin Hill, 15-20.vii.1962, Y. Hirashima, 2♂ 1♀ (BPBM); Tawau Residency, Kalabakan R., 30 mi. West of Tawau, 9-18.xi.1958, T. C. Maa, 1♂ (BPBM); Sandakan Dist., Rumidi, R. Labuk, 16-30.ix.1973, C. Pruett, B.M. 1975-590, 19♂ 1♀ (BMNH); Tawau, Brumas Camp, xi.1974, C. Pruett, B.M. 1975-590, 14♂ 2♀ (BMNH); Tawau, Taman Bukit Tawau, 1-13.v.1992, Ruslan, 13♂ 8♀ (UKM); Ulu Dosun Palm Oil Research Stn, 50 km W of Sandakan, iv.1978, J. Frazier & D. Clyne, 1♀ (Moulds). – BRUNEI: Temburong district, ridge NE of Kuala Belalong, approx. 300 m alt., x.1992, J.H. Martin coll., 125 m.v. light, B.M. 1992-172, 7♂ 5♀, same data but xi.1992, 4♂ 1♀ (BMNH); Brunei, Waterstradt, 1♀ (BMNH). – INDONESIA, KALIMANTAN: Boeloengan, 1♂ (ZMA); Boeloengan, Matthes, Museum Natura Artis Magistra, 1♂ (ZMA); Kayan-Mentarang Nature Reserve, Lalut Birai, IIS 940507, WWF, 1♂ (NSMT); Berau, 30.iv.1997, D. Cleary, 1♂ (ZMA). – KOREA: Corea, 47 21, 1♀ paracotype of *Dundubia phaeophila* (BMNH).

### *Orientopsaltria maculosa* sp. n.

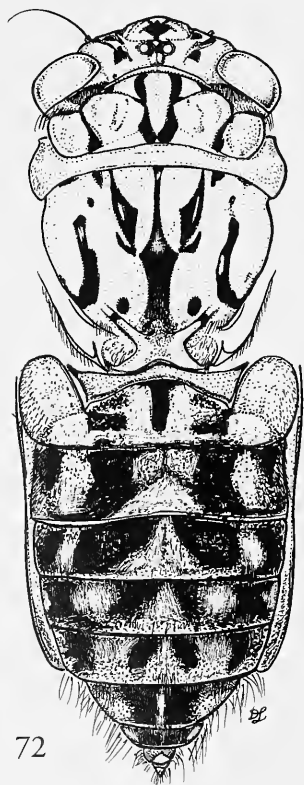
(figs. 49, 68, 72-75, plate 3: 4)

Type material. – 88♂ 31♀. Holotype ♂: 'RMNH E.Sabah / Lahad Datu, 60 km W of / Danum Valley Field Centre / at junction Sg Segama and / Sg Palum Tambun, 150 m / 4°58'N 117°48'E', at light. Bridge of Segama / 20 Mar. 1987 18.20-21.00 / clearing, edge of untouched / evergr. lowl. rainforest / leg. Van Tol & Huisman' (RMNH). – Paratypes: MALAYSIA: SABAH: same data as holotype but; 17-18.iii.1987, 1♂ (ZMA); Lembah Danum, 17.iv.1994, John, 4♀, same data but 2.ii.1994, 1♀ (UKM); Lembah Danum, 4-7.xii.1990, Zaidi, Ismail, Ruslan, 1♀ (UKM); Lembah Danum, 25-30.viii.1991, M.S., Zaidi, Mail, Lan, 3♂ 1♀ (UKM); Lembah Danum, 22-26.viii.1992, Ismail, Sham & Yusof, 2♂ (UKM); Danum Valley, Danum Valley Fld Centre, 100-200 m, 18-29.x.1987, multi-str. evergr. forest along river, at light, Krikken & Rombaut, 2♂ 2♀ (RMNH); 60 km W of Lahad Datu, DVFC, nr Segama bridge, 4°58'N 117°48'E, 150 m,

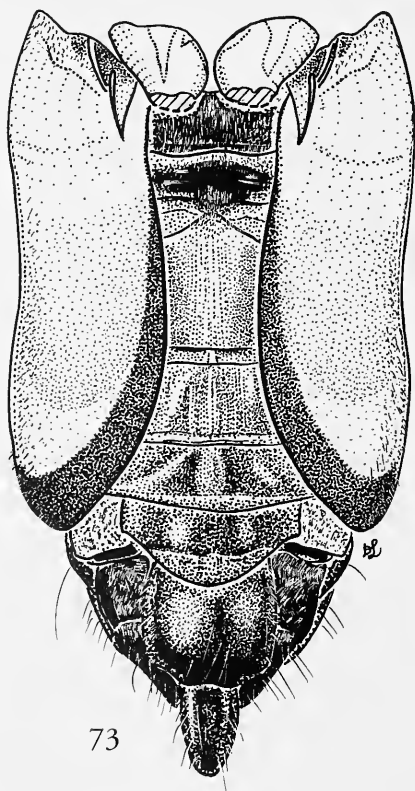
20.x.1987, J. Huisman & R. de Jong, 2♀ (RMNH); 75 km W Lahad Datu, confl. S. Sabran / S. Danum, S/N, 117°41'E 4°57'N, 200 m, 23.x.1987, J. Huisman & R. de Jong, 1♂ (RMNH); 65 km W of Lahad Datu, S. Purut camp, 117°45' E 4° 57'N, 200 m, 26.x.1987, ML-light, J. Huisman & R. de Jong, 1♂ (RMNH); Danum Valley, 70 km W Lahad Datu, Sungai Segama, W side suspension bridge, 150 m, 29.xi.1989, sample Sab. 47, understorey secondary growth/canopy riverine rainforest, at light, M.J. & J.P. Duffels, 3♀ (ZMA); Danum Valley, 70 km W Lahad Datu, Field Centre, Main Trail West 0 North 5, 150 m, 16.xii.1989, sample Sab. 71, secondary vegetation/canopy/primary forest margin, at light, M.J. & J.P. Duffels, 1♀ (ZMA); DVFC [Danum Valley Field Centre], 23.iv.1994, Shan, 1♂ (UKM); Kalabakan, 10-19.xi.1958, L.W. Quate, Light Trap, 3♂ (BPBM); 19 km N of Kalabakan, Forest Camp, 19.x.1962, K.J. Kuncheria collector Bishop, 1♂, same data but 20.x.1962, 1♂ (BPBM) 1♀ (ZMA); 19 km N of Kalabakan, Forest Camp, 28.x.1962, Y. Hirashima, 1♂, same data but 19.xi.1962, Malaise Trap, 1♂ (BPBM); 19 km N of Kalabakan, Forest Camp, 23.x.1962, Y. Hirashima, Light Trap, 1♂, same data but with: 60 m, 1♀, same data but 18.xi.1962, 1♀ (BPBM); T. Negara, G. Kinalu, 13-15.xii.1990, Zaidi, Ismail, Ruslan, 1♀ (UKM); Sandakan Dist., Rumidi, R. Labuk, 16-30.ix.1973, C. Pruett, B.M. 1975-590, 1♂ (BMNH); 20 km W Sandakan, Sepilok-laut, nr. Resthouse, 118°06'E 5°49'N, 4.xi.1987, 0 m, ML-light, J. Huisman & R. de Jong, 1♂ (RMNH); Sepilok, ca 50 m, 26.vi.1987, Akira Ueda leg., 00234, 1♂ (UKM); Tawau District, Kalabakan, 8-12.xi.1958, primary forest, T.C. Maa, 3♂ (BPBM); Tawau, Brumas Camp, xi.1974, C. Pruett, B.M. 1975-590, 2♂ (BMNH); Tawau, Cocoa Res. Station, 23.viii.1962, J. Sedlacek, 1♂ (ZMA); Tawau, Quoin Hill, Cocoa Res. Station, 19.xi.1962, Y. Hirashima, 1♂ (BPBM); Tawau, Taman Bukit Tawau, 1-13.v.1992, Ruslan, 3♂ (UKM); Tawau, Maliau Basin, 12-25.v.1996, light trap, 1♂ (UMS); Ulu Dosun Palm Oil Research Stn, 50 km W of Sanoakan [= Sandakan], iv.1978, J. Frazier & D. Clyne, 1♂ 1♀ (Moulds); Sabah, UKMS, 5.viii.1994, Lim, 1♂ (UKM). – SARAWAK: Baram riv. district, 1912, H. W. Smith, 1♂ (MCZ); Baram, 15.ii.1920, J.C. Moulton, Pres. Raffles Mus. Singapore, Brit. Mus. 1922-302, 1♂ (BMNH); Belaga, 9.viii.1983, M. Heldgaard, 1♂ (UZMK); Sarawak, Bintangoi, 6.ii.1994, Lawrence Iu, 1♂ (UKM); Bintulu, 14.viii.1994, Zaidi & Talib, 4♂ (UKM); Bintulu, Kampus UPM, 10.iii.1992, Zaidi, 2♂, same data but 2-3.iii.1992, 4♂ (UKM); Bintulu, Taman Hidupan, Liar, 3.iii.1992, Zaidi, 1♂ (UKM); Julau, Lanjak Entimau, 28-29.ii.92, Zaidi, 5♂ 1♀ (UKM); Mt. Dulit, 4000 ft, moss forest, 2.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 8.0-9.30 P.M., rainy & cold, at light

in house, 4♂ (BMNH); 4th Div., Niah, 7-17.x.1976, 3°49'N 113°46'E, P.S. Cranston, B.M. 1977-19, 1♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 29.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, in house, B.M. 1933-254, 1♂ (BMNH); Gunung Mulu Nat. Park, Site 7, Long Pala (Base), 324450, 50 m, Alluvial/secondary forest, Acl-understorey, J.D. Holloway, RGS Mulu expd., B.M. 1978-206, 1♂ 1♀, same data but: Site 8, Camp 1, Mulu, 385470, 150 m, mixed dipt. for., February, MV - mainly canopy, 1♂, Site 14, Camp 2.5, Mulu, 413461, 1000 m, Lower l. montane forest, February, MV - canopy / understorey, 1♂, Site 16, Long Pala (Base), 324450, 70 m, Allu./second. forest, MV-on batu-Canopy, March, 6♂, Site 23, W. Melinau Gorge, 430558, 250 m, FEG 4, limestone forest, April, MV - canopy / understorey, 3♂, site 28, Nr. Long Pala, FEG 1a, 328428, 50 m, alluvial forest, MV-understorey, 1♀ (BMNH); Keduron, Moulton, Distant coll.1911-383, 2♂ (BMNH). – BRUNEI: Tem-

burong district, ridge NE of Kuala Belalong, approx. 300 m alt., x.1992, J.H. Martin coll., 125 m.v. light, B.M. 1992-172, 1♂ (BMNH). – INDONESIA: KALIMANTAN: Bloe-oe, 18.ix.1894, Borneo Exped. Dr. Nieuwenhuis, 1♀ (RMNH); Bulungan, Kayan Mentarang Nature Reserve, IIS 930000, Res. Stn. 20.2-4.iii.1993, 1° rainforest, mixed dipterocarp, 355 m, 02°48' N 115° 38' E, D. C. Darling, 1♂ 1♀ (ROME) 1♂ (ZMA); Kayan-Mentarang Nature Reserve, Lalut Birai, IIS 940507, WWF station, 28.3-16.iv.1994, lowland diptero forest, 378 m, 2°52'N 115°49'E, UV light, B. Hubley & D.C. Darling, 2♂ 3♀ (ROME); Long Bloe-oe, 12.1898, Borneo Exped. Dr. Nieuwenhuis, 1♂ (RMNH); Mahakkam, 1894, Borneo Exped. Dr. Nieuwenhuis, 1♂ 2♀ (RMNH); Long Bia, Sungai Kayan, Kabupaten Bulungan, c. 50 m s.s.l., 3°19'N 116°48'E, 29.ix.1996, in village surroundings with many ladangs and secondary forest of different ages, V. Nijman, 5♂ (ZMA); Berau, 30.iv.1997, D. Cleary, 1♂ (ZMA).



72



73

Figs. 72, 73. *Orientopsaltria maculosa*, male. – 72, body in dorsal view, holotype, Sabah Danum Valley Field Centre, at junction Sg Segama and Sg Palum Tambun; 73, abdomen with opercula in ventral view, Sabah, 65 km W of Lahad Datu, S. Putut camp.

This species appears to be endemic to the northern half of Borneo. It is recorded from the Malaysian states Sabah and Sarawak, from Brunei, and from mainly the northern part of Kalimantan (fig. 74). *O. maculosa* can easily be separated from *O. angustata*, *O. guttigera* and *O. phaeophila* by the conspicuous black marking on the abdomen (fig. 72), the presence of a pair of black lines on the pronotum running along the posterior oblique fissures (fig. 72), and by a smaller uncus lobe with a distinctly broader lateral spine (fig. 75). *O. maculosa* is very similar to *O. angustata* in shape and coloration of the male operculum.

### Description

Ground colour of body brownish often with greenish tinge. Marking black on head and thorax, and black to brownish on abdomen.

Head. — Head from dorsal aspect with large black mark that encloses the ocelli, narrows distad toward frontoclypeal suture, and continues on postclypeus in a median line or an anchor shaped spot extending distad to median oval spot of the ground colour on anterior part of postclypeus; in 70% of the specimens the median mark enclosing ocelli is connected with posterior margin of head by two narrow lines or a fairly broad fascia, while these lines or fascia are miss-

ing in the other specimens. A pair of fascia run parallel to the inner curve of eye from vertex lobe to almost posterior margin of head at a distance of  $1.5-4\times$  as wide as fascia; the fasciae are sometimes broken up in 1-3 short lines or spots equally distant from eye. Anterior part of postclypeus with 4-5 transverse lines on either side, median ends of these lines connected by a line enclosing an oval spot of the ground colour; upper lines reaching to supra-antennal plates, lower lines often shorter. Ventral side of postclypeus with very variable marking: a median line is missing or narrow in 20-30% of the specimens, while the others have a median line that (very) strongly widens to a large black mark at the clypeal suture. Anteclypeus with a pair of dark spots. Genae black coloured along anteclypeus. Ventral side of vertex lobe with either a fascia connecting the base of the antenna with the eye, or a spot between base of antenna and eye, or unmarked. Rostrum with black apex, just reaching posterior margins of hind coxae.

Thorax. — Pronotum. Paired central fasciae uninterrupted and equally wide along their whole length, connected proximad at anterior margin of pronotal collar and slightly diverging to anterior margin of pronotum. A pair of narrow but distinct fasciae run from the eye along the posterior oblique fissures to

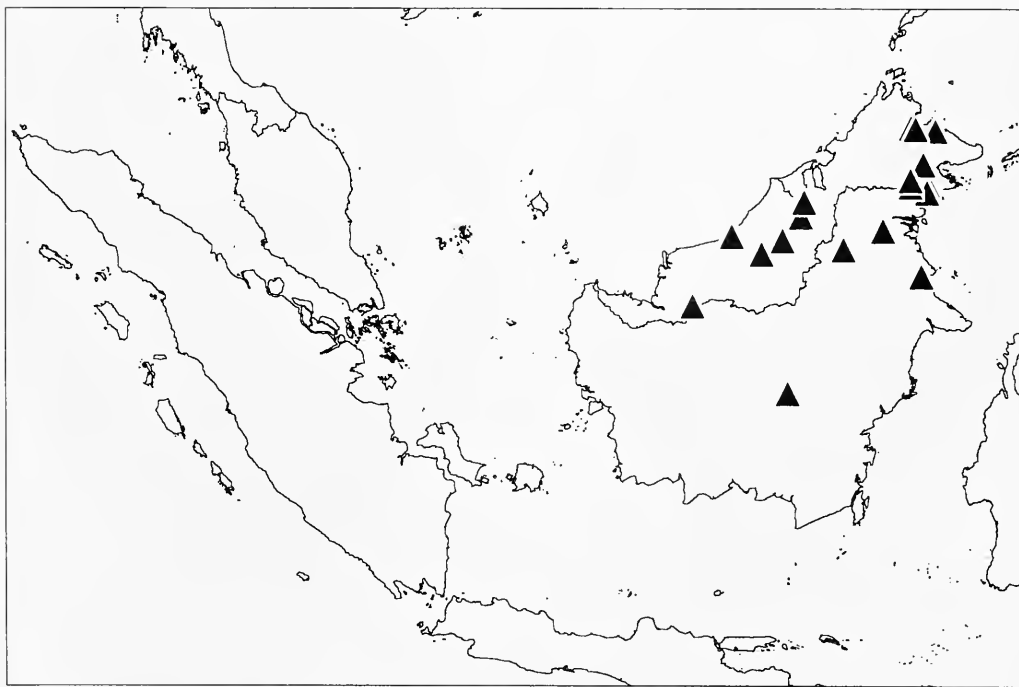


Fig. 74. Distribution of *Orientopsaltria maculosa*.

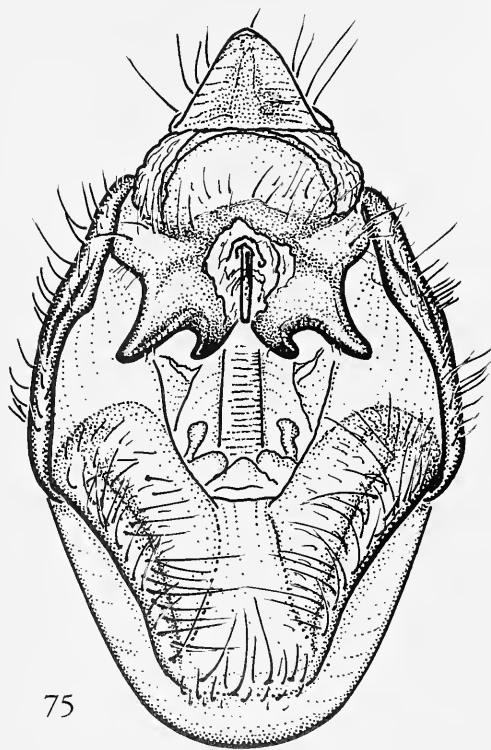
anterior margin of the pronotal collar. A couple of specimens have a pair of faint spots at half-length of pronotum, half way between the two pairs of fasciae.

Mesonotum. – Five black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation; this fascia is anteriorly very narrow, at half-length of mesonotum strongly widened to  $4-5\times$  its anterior width, and posteriorly slightly narrowed. Paramedian fasciae extending from anterior margin to about half-length mesonotum; fasciae anteriorly as wide as or slightly narrower than anterior part of median fascia, widened along medial side to  $3-6\times$  their anterior width at half their length, and slightly narrowed to posterior end, which is often apically recurved and sometimes connected with median fascia. Paramedian fasciae at half-length  $2-3\times$  as wide as distance between paramedian and median fascia at this level. A pair of small round spots in front of anterior angles of cruciform elevation. Lateral fasciae reaching from one third or one fourth of mesonotum length to nearly posterior margin of

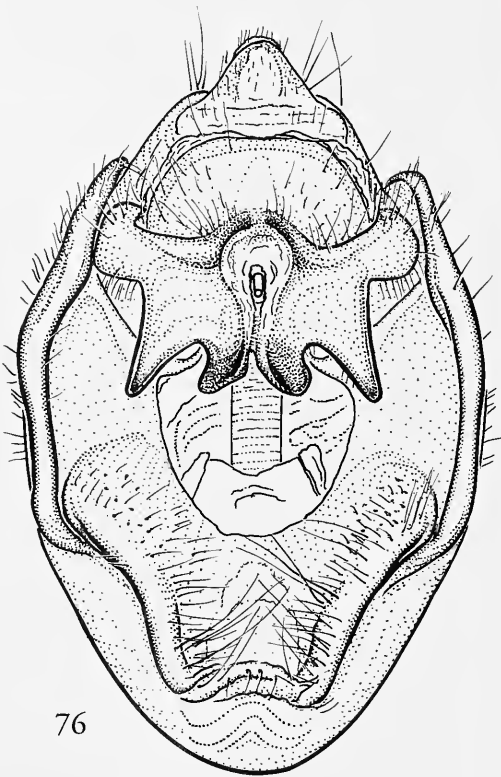
mesonotum. Anterior part of lateral fasciae one third to half as wide as distance between paramedian and lateral fasciae. A pair of very small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae and sometimes a pair of small spots between these black triangles and proximal part of lateral fasciae.

Legs. – Fore femora with subapical brown marks on inner- and outsides, sometimes with a brown fascia on outside, and with a black-brown line connecting the spines along lower edge; hind femora with broad dark brown fascia on posterior side. Fore tibiae with about distal half of inside and distal one sixth of outside black-brown; middle and hind tibiae with distal one fourth to one third black-brown; hind tibiae proximally also black-brown. Tarsi of fore and middle legs dark brown to black.

Tegmina and wings. – Hyaline. Tegmina with basal veins of 2nd and 3rd apical areas distinctly infuscated, and those of 5th and 7th apical areas less infuscated; apices of longitudinal veins weakly infuscated.



75



76

Figs. 75, 76. Male pygofer in ventral view. – 75, *Orientopsaltria maculosa*, holotype, Sabah Danum Valley Field Centre, at junction Sg Segama and Sg Palum Tambun; 76, *Orientopsaltria hollowayi*, holotype, Sarawak, Gunung Api.

### Male

Operculum (figs. 68, 73). – Shape and coloration of operculum very similar to that of *O. angustata*. The operculum is elongate and fairly narrow, and reaches to half-length abdominal segment 6 or to just beyond this segment. A vague transverse brownish area at half or two thirds of operculum length is found in most of the specimens.

Abdomen. – Segment 2 with mediodorsal, obconical to triangular black spot at anterior margin. Segments 2–4 dorsally with a pair of very conspicuous, paramedian, more or less rectangular black marks; marks on segment 2 often reaching from posterior segment margin to about half the segment length, with latero-proximal corner of rectangle reaching medial corner of timbal covering, while the marks on segments 3 and 4 often reach from anterior to posterior segment margins. However, the paramedian marks on segments 2–4 are in some specimens considerably shorter than described above. Marks on segments 2–4 about 1.5× as broad as long. Segments 3–4 with faint brownish to black-brown lateral spots. Segments 5–6 with two juxtaposed central black spots at anterior segment margin reaching to about half the segment length, a pair of conspicuous black sublateral rectangles often extending along the whole segment length, and lateral brownish suffusion. Segment 7 with black medial marking and brownish lateral suffusion. Segment 8 almost entirely black. Ventral side of abdomen proximally light brown and turning to black or black-brown from segment 6 to the posterior.

Genitalia (fig. 75). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with fairly broad outcurved ridges. Uncus with large and distinctly globose basal part. Uncus lobe with fairly short and broad, outcurved, lateral spine, and with a shorter hook-shaped medial spine; lateral margin of uncus lobe basally concave and further straight. Arcuate ridge over narrow gap between uncus lobes fairly strongly elevated and outcurved.

### Female

Operculum (fig. 49). – Ochraceous, reaching to one third or one fourth of length of abdominal segment 3; lateral margin with basal half undulate, and apical half oblique, straight or weakly convexly curved, and dark brown coloured to the obtuse laterodistal angle; distal margin weakly convex but strongly convex toward meracanthus.

Abdomen dorsally with median line or spot at anterior margin of segment 2, a pair of faint fairly small central spots at anterior margins of segments 5–8, a pair of large transverse paramedian dark brown spots on segments 3–4, a pair of large sublateral spots on segments 5–6, and with a pair of distinct, triangular black-brown marks at anterior margin of segment 9.

Dorsal side of abdomen covered with scattered silvery pilosity especially on lateral parts of the segments. Ventral side of abdomen brown with black-brown coloration along posterior margins of sternites and along lower margins of segment 9, and with a fairly broad dark brown medial fascia on sternite 7.

Measurements (n= 6♂ 6♀). – Body length ♂ 28.5–30.5 mm, ♀ 24.5–27 mm; head width ♂ 9.5–10.4 mm, ♀ 9.3–10.0 mm; pronotum width ♂ 9.9–11.1 mm, ♀ 9.5–10.7 mm; tegmen length ♂ 38.5–41.5 mm, ♀ 36–40 mm.

### Variability

Light-coloured specimens are found in SE Sabah (Danum Valley and Kalabakan (Forest Camp)) and in NE Kalimantan (Kayan Mentarang Nature Reserve). Dark-coloured specimens occur over the whole range of the species. The light-coloured specimens from Danum Valley in SE Sabah differ from the dark-coloured specimens from Sarawak in West Borneo in the following features: (1) the narrow median line on the postclypeus is not, or sometimes slightly, widened at the clypeal suture in the Danum material, but most often very strongly widened in the Sarawak material, (2) the fascia parallel to the inner curve of the eye is reduced to spots and short lines in the Danum material, but most often uninterrupted in the Sarawak material, (3) the fascia connecting the base of antenna and the eye is missing, or reduced to a small spot only, in the Danum material, but uninterrupted in the Sarawak material, (4) the marking on the abdomen is less conspicuous in the Danum material than in the Sarawak material.

### *Orientopsaltria hollowayi* sp. n. (figs. 76–79, 87, plate 4: 1)

Type material. – 3♂. Holotype ♂: 'SARAWAK / Gunung Mulu / Nat. Park', 'Site 26, April / G. Api Pinacles / 1200 m, 428545 / Open scrub, MV', 'J.D. Holloway / RGS Mulu exped. / B.M. 1978–206' (BMNH). – Paratypes: MALAYSIA: SARAWAK: Gunung Mulu Nat. Park, Site 14, Camp 2.5, Mulu, 413461, 1000 m, Lower l. montane forest, February, MV - canopy / understory, J.D. Holloway, RGS Mulu exped., B.M. 1978–206, 1♂ (BMNH). – SABAH: West Coast, Poring, viii.1981, T. Yasuda, Natn. Sci. Mus. Tokyo: Loan No. He-97-009, 1♂ (NSMT).

This species is recorded from Sarawak and Sabah in northern Borneo (fig. 79). It can be recognised easily by its mesonotum marking, its fairly broad but interrupted central fasciae on the pronotum (fig. 77), and by the yellow area between the transverse castaneous fascia and the black apical coloration in the male op-

ercula (fig. 78). The tegmina show a large infuscation at the apex of cubital vein CuA1. This infuscation is connected with the infuscation at the basal vein of the 7th apical area, as is also the case in *O. kinabaluana*. *O. hollowayi* can be distinguished from *O. angustata*, *O. guttigera* and *O. phaeophila*, by the shorter and broader lateral spine of the uncus lobe and the broad, apically rounded medial protrusion of this lobe. The latter character also separates *O. hollowayi* from *O. maculosa*.

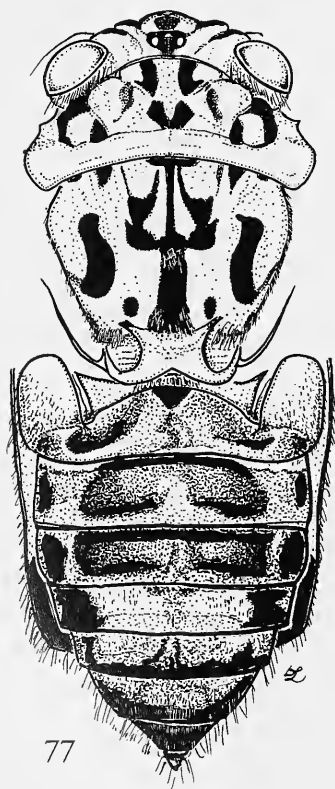
#### Description of male

Ground colour of body vividly brownish with greenish tinge; ground colour of one of the paratypes brownish. Marking on body black to brownish.

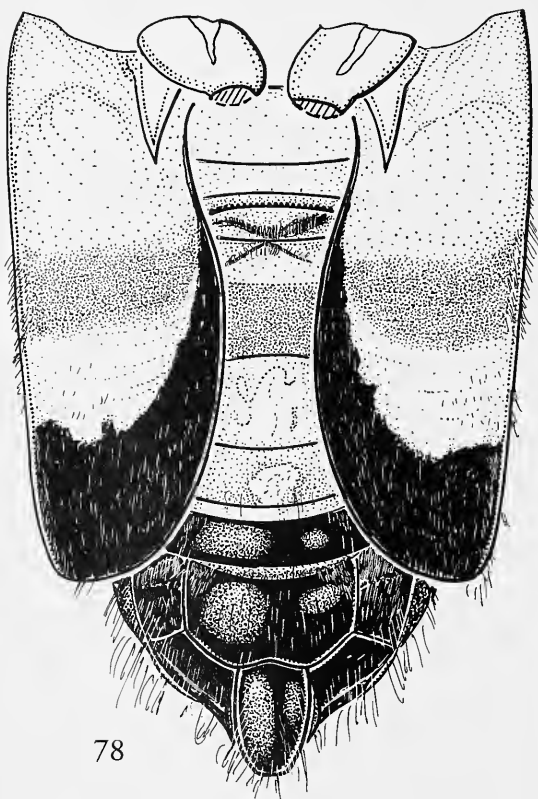
Head. – Head from dorsal aspect with large black oval mark that encloses the ocelli, narrows distad toward frontoclypeal suture, and continues on postclypeus in an anchor shaped spot that extends distad to median ground coloured oval spot on anterior part

of postclypeus; the median mark enclosing ocelli narrows proximad to posterior margin of head. Supra-antennal plate with triangular black spot; vertex lobe with short black stripe. Anterior part of postclypeus with 4-6 transverse dark lines on either side, median ends of these lines connected by a line enclosing an oval spot of the ground colour. Ventral side of postclypeus with narrow, median, black-brown line reaching from ground coloured oval spot (nearly) to clypeal suture. Rostrum with brown apex, reaching beyond hind coxae.

Thorax. – Pronotum. Paired central fasciae black, fairly broad, interrupted at proximal ends of anterior oblique fissures; the posterior parts are two more or less crescentic, juxtaposed spots at anterior margin of pronotal collar, the anterior parts are two fasciae diverging distad, that just not reach the anterior pronotum margin. Posterior ends of oblique fissures with a black triangle at anterior margin of pronotal collar; lateral part of ambient fissure more or less black. A



77



78

Figs. 77, 78. *Orientopsaltria hollowayi*, male holotype, Sarawak, Gunung Api. – 77, body in dorsal view; 78, abdomen with opercula in ventral view.

pair of lanceolate, brown to black spots situated between two pairs of oblique fissures.

**Mesonotum.** – The median fascia is very narrow from anterior margin to half-length of mesonotum, where it widens to 5–6× its anterior width, and remains equally wide or narrows slightly to cruciform elevation. The holotype and the paratype from Sarawak have very characteristic paramedian, obconical marks reaching from anterior margin to half-length of mesonotum and consisting of very narrow (holotype) or fairly broad (paratype) lines forming outer margins of obconical marks that are only distally filled up with black. Apex of each obconical mark with brownish to black-brown crescentic cap that connects obconical mark and median fascia. Paramedian marks in the paratype from Sabah reduced to a small black mark at one third of mesonotum disk. A pair of fairly small black spots in front of cruciform elevation, and apices of anterior branches of cruciform elevation black. Lateral fasciae broad, reaching from one third to fifth sixth of length of mesonotum disk; widest distal part of fascia about as wide as broadest part of median fascia; in the paratypes proximal part of lateral fascia curved mediad and continuing in a much narrower black line running proximad to posterior margin of pronotum; the holotype has a

pair of very small, black triangles at anterior margin of mesonotum laterally of paramedian marks.

**Legs.** – Fore femora with subapical dark mark on inner-, upper- and outsides, and dark streaks on upper- and outsides; hind femora with apical third of lower side brownish. Apical one fifth of tibiae of all legs and apical one eighth of upperside of tibiae of hind legs black-brown. Tarsi of fore and middle legs black-brown.

**Tegmina and wings.** – Tegmina with large infuscations at basal veins of 2nd, 3rd, 5th and 7th apical areas, with small but distinct infuscations at apices of longitudinal veins of apical areas 2–6, and with large infuscation at the apex of the cubital vein CuA1. This infuscation is often connected with the infuscation at the basal vein of 7th apical area. Venation of tegmen and wing light to dark brown.

**Operculum** (figs. 78, 87). – Fairly broad but narrower in the paratype from Sabah, reaching (almost) posterior margin of abdominal segment 6. Medial margin evenly convex. Lateral margin fairly convex in basal part, weakly concave at two fifths of length from base, and very weakly convex, in fact almost straight, toward rounded apex. Black coloration along medial margin gradually widens from one third of length from base to black apical part of operculum. A trans-

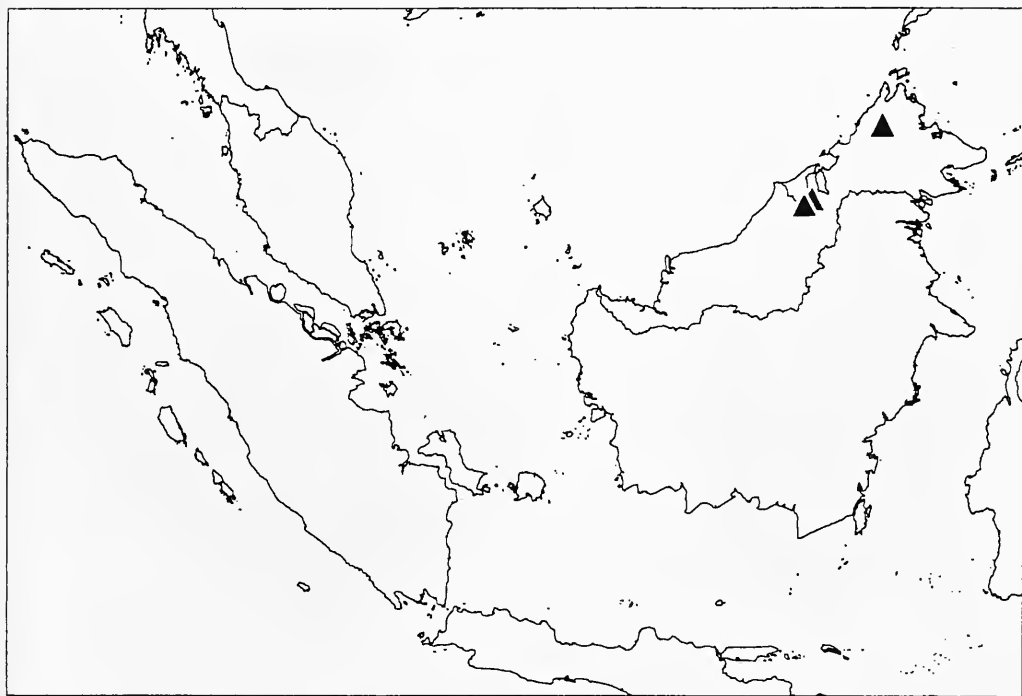


Fig. 79. Distribution of *Orientopsaltria hollowayi*.

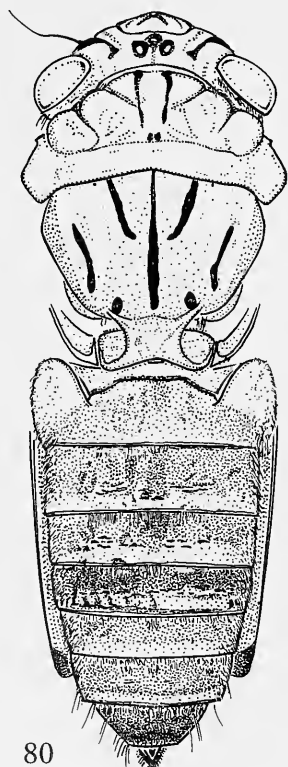
verse castaneous fascia, one fifth as high as length of operculum, is situated at half-length of the operculum. Area between fascia and black apical coloration, which is one fifth as high as length of operculum, yellow. Basal part of operculum of ground colour.

Abdomen. – Abdomen brownish with greenish tinge, and with somewhat darker brownish, not very distinct marking. Segment 2 with triangular, medio-dorsal, black-brown mark reaching to one fourth of segment length. Segments 2-4 with, sometimes very faint, pair of paramedian, transverse marks, which are maximally half as high as the segment and  $6\times$  as broad as high and laterally connected with dark anterior margin, and pair of lateral marks. Lateral marks on segment 3 enclosed in conspicuous patch of white wax with silvery hairs. Segment 5 with pair of faint, sublateral rectangular marks, extending along whole segment length. Segments 6 and 7 somewhat darker coloured

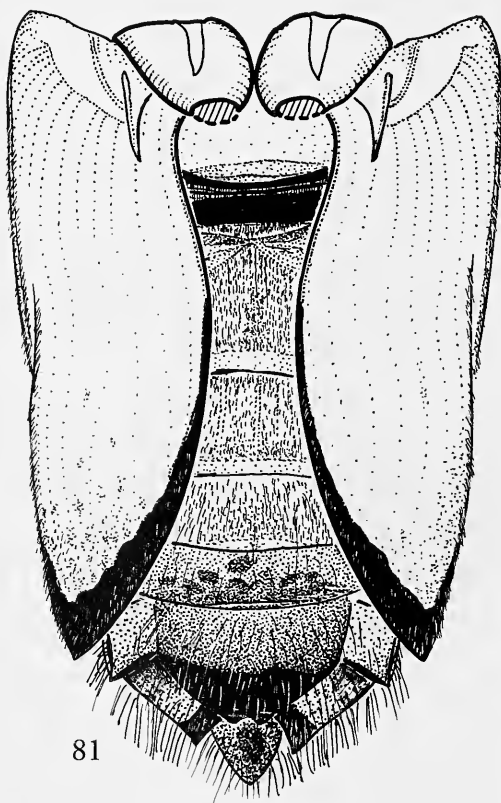
on posterior half, dark coloration on segment 6 extends laterally to anterior margin of segment. Segment 8 dark brown. Ventral side of abdomen proximally light brown and turning to black or black-brown from segment 6 to the posterior.

Genitalia (fig. 76). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with fairly broad outcurved ridges. Uncus with large and distinctly globose basal part. Uncus lobe with fairly short and broad, outcurved lateral spine, and with a shorter but very broad and apically rounded medial protrusion; lateral margin of uncus lobe basally concave and further straight. Arcuate ridge over narrow gap between uncus lobes fairly strongly elevated and outcurved.

Measurements ( $n=3\delta$ ). – Body length 34.5-35.5 mm; head width 11.0-11.2 mm; pronotum width 12.0-12.7 mm; tegmen length 45-46.5 mm.



80



81

Figs. 80, 81. *Orientopsaltria ida*, male. – 80, body in dorsal view, Kalimantan, Long Nawang; 81, abdomen with opercula in ventral view, Brunei, ridge NE of Kuala Belalong.

***Orientopsaltria ida* group****Diagnosis**

The *ida* group contains two medium-sized to fairly small species (body length male: 28–32 mm): *O. ida* and *O. palawana*. *O. ida* is recorded from the Malayan Peninsula and Borneo, while *O. palawana* is an endemic of Palawan island.

The two species of this group have unspotted tegmina, a character that is also found in the two species of the *sumatrana* group. The species of the *ida* group are characterized by the fairly broad lateral and medial spines of the uncus, that both point laterad (figs. 82–83).

***Orientopsaltria ida* (Moulton, 1911)**

(figs. 50, 80–82, 84, 88, plate 4: 2)

*Cosmopsaltria ida* Moulton, 1911a: 134, 139. Holotype ♂: 'Borneo, Kedurong, Light House, Sep. 1910', 'Kedurong, Light House, September, 1910', '1912-307', 'TYPE ♂, *Cosmopsaltria ida*, Moulton', '*Cosmopsaltria ida* Moulton, ♂ TYPE', 'TYPE' (round label; red circle) (BMNH) [examined].

*Cosmopsaltria ida*; Moulton 1911b: 185, 189; Distant 1912: 44; Moulton 1917: 3; Moulton 1919: 64; Moulton 1923: 88, 91, 167, pl. 2, figs. 3, a, b; Metcalf 1963: 549.

*Orientopsaltria ida*; Duffels 1983: 9; Zaidi & Hamid 1996: 53, 56; Zaidi & Ruslan 1995b: 198, 200, 201, 203; Zaidi & Ruslan 1995c: 218, 219, 221; Zaidi et al. 1996: 60; Duffels & Zaidi 1998: 321.

*Cosmopsaltria ida* was described after one male. The specimen mentioned above is regarded as the holotype of *Cosmopsaltria ida*. Another specimen in BMNH bearing the labels: 'Kedurong, Light House, September 1910', 'Distant Coll. 1911-383', 'Co-Type *Cosmopsaltria ida*, Moulton', is not a type specimen.

*O. ida* can easily be distinguished from the other species of this group, *O. palawana*, by the absence of a transverse brown fascia at half-length of the male operculum. The structure of the male uncus lobe of *O. ida* (fig. 82) is very similar to that of *O. palawana* (fig. 83). Females of *O. ida* can be separated from the other species of *Orientopsaltria* by a very long attenuate abdomen. *O. ida* has been recorded from Borneo (Sabah, Sarawak, Brunei and Kalimantan), and from the province of Pahang in Peninsular Malaysia (fig. 84).

**Description**

Ground colour of head and thorax brownish with greenish tinge, abdomen brownish.

Head. – Head from dorsal aspect with either a median trefoil shaped black mark that just encloses the ocelli and extends in some specimens to frontoclypeal

suture, or with a black ring around each ocellus. Anterior part of supra-antennal plate with triangular, black mark, and vertex with 1–3 pairs of very small brown to black dots on a row, half way between ocelli and eyes; in some specimens the black mark on the vertex lobe continues proximally in a narrow black line enclosing the spots of the anterior two pairs. Anterior part of postclypeus with 4–6 transverse, black or occasionally brown, lines on either side, median ends of these lines connected by a line forming a median oval figure on anterior part of postclypeus. Genae black coloured along anteclypeus. Apical margin of anteclypeus sometimes with narrow black line. Rostrum with black-brown apex reaching to halfway hind coxae.

Thorax. – Pronotum. Paired central fasciae in very few specimens uninterrupted, very narrow, black, and slightly diverging from anterior margin of pronotal collar to anterior margin of pronotum, and with proximal and distal ends widened, but in most specimens the central fasciae are reduced to pairs of spots at anterior margin of pronotum and at anterior margin of pronotal collar, and a pair of stripes at half-length of pronotum. Posterior margin of pronotal collar black.

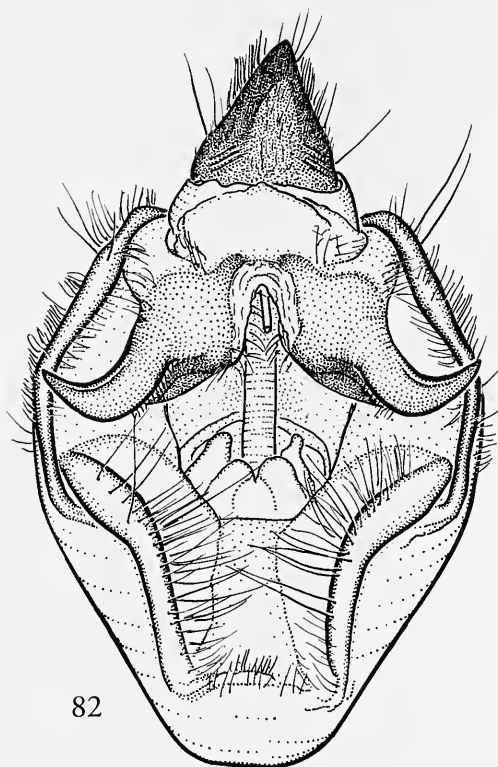
Mesonotum. – Five narrow black fasciae, but in some specimens the lateral fasciae are missing. Median fascia reaching from anterior margin of mesonotum to cruciform elevation, either equally wide along its whole length or slightly widened at half-length to maximally 3× its anterior width. Paramedian fasciae slightly converging from anterior margin of mesonotum to half-length of mesonotum, as wide as or slightly wider than anterior part of median fascia. A pair of small round spots in front of anterior angles of cruciform elevation. Lateral fasciae sometimes missing, but often present and reaching from half or three fifths of mesonotum length to nearly posterior margin of mesonotum; lateral fasciae as wide as paramedian fasciae and much narrower than distance between lateral and paramedian fasciae. Some specimens have a pair of black triangles at anterior margin of mesonotum lateral of paramedian fasciae.

Legs. – Brownish. Apical parts of tibiae of all legs dark brown or black. Tarsi of fore and middle legs dark brown to black.

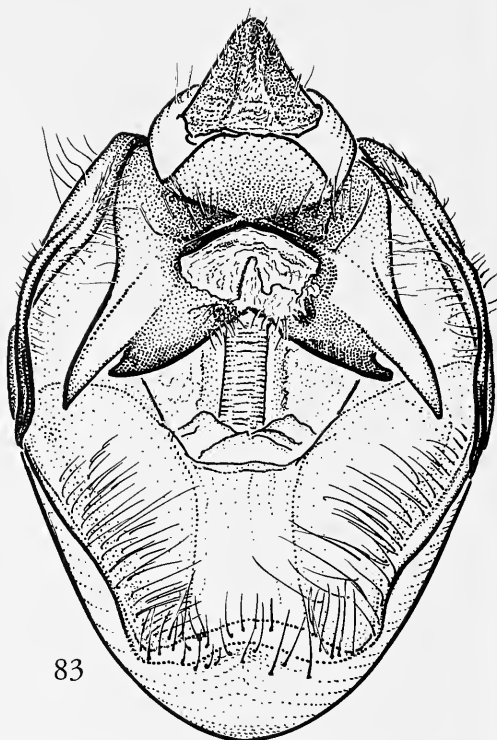
Tegmina and wings. – Hyaline with faint brownish suffusion, and without spots. Tegmen with basal half of venation reddish brownish, apical venation dark brown; wing venation dark brown.

**Male**

Operculum (figs. 81, 88). – Elongate but fairly broad, reaching posterior margins of abdominal segment 6 to 7. Medial margin evenly convex. Lateral



82



83

Figs. 82, 83. Male pygofer in ventral view. – 82, *Orientopsaltria ida*, Kalimantan Timur, Long Bagun; 83. *Orientopsaltria palawana*, holotype, Palawan, Matalingajan, Pinigisan.

margin slightly convex in basal third, weakly concave at one fourth of its length from base, and weakly convex in apical three fourths up to narrowly rounded apex. Medial margin with black border, which is very narrow at half-length but slightly widens distad toward black coloured apical one eighth of operculum.

Abdomen. – Dorsal side brownish without marking, timbal coverings somewhat lighter than tergites, ventral side brown, posterior margin of 7th sternite dark brown.

Genitalia (fig. 82). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes ear-shaped with thick margins which are basally more or less parallel. Uncus with large and distinctly globose basal part. Uncus lobe with strongly developed recurved lateral hook with sharply pointed apex, and a short and fairly broad, weakly curved, medial hook, that is partly hidden behind the lateral hook; lateral margin of uncus lobe strongly concave to apex of lateral hook. Arcuate ridge between uncus lobes over apex of aedeagus strongly elevated and outcurved.

## Female

Operculum (fig. 50). – Pale ochraceous, reaching to one fourth of length of abdominal segment 3. Lateral margin weakly undulate to the slightly protruded laterodistal corner of the operculum. Posterior margin weakly undulate but strongly convexly curved medially toward the meracanthus.

Abdomen. – Segment 9 very long, and ovipositor extending to far beyond the apex of segment 9. Abdomen dorsally ochraceous to light brown, with scattered silver pilosity, and a pair of paramedian dark brown fasciae extending from anterior margin of segment 9 to two-thirds of segment length; ventrally ochraceous to light brown without marking

Measurements (n= 6♂ 3♀). – Body length ♂ 28-32 mm, ♀ 28.5-29.5 mm; head width ♂ 9.3-9.8 mm, ♀ 9.0-9.5 mm; pronotum width ♂ 9.6-10.2 mm, ♀ 9.2-10.0 mm; tegmen length ♂ 37-38.5 mm, ♀ 35-39 mm.

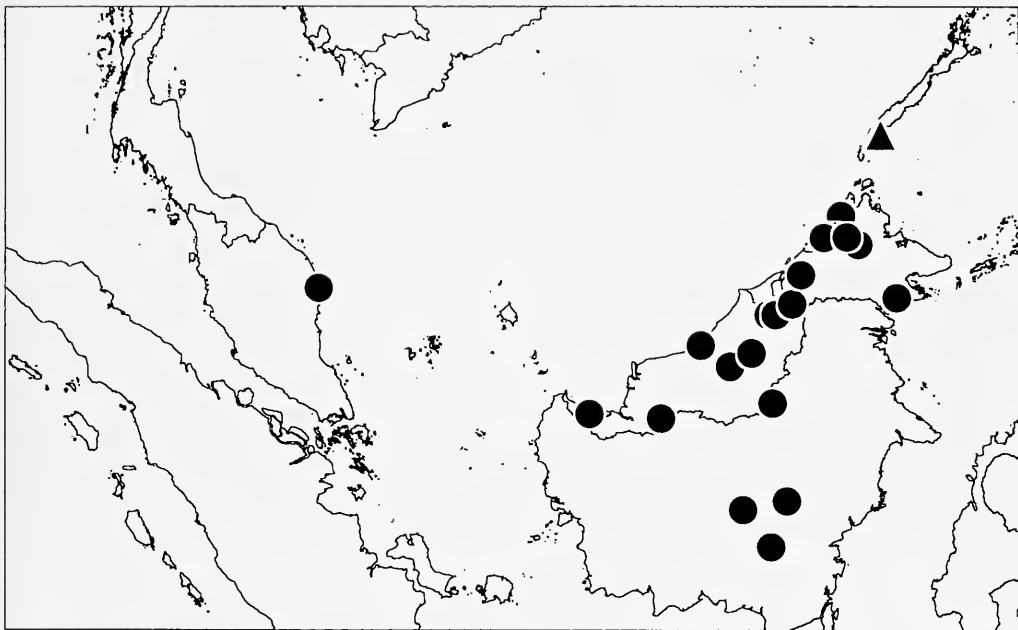


Fig. 84. Distribution of *Orientalis ida* (rounds) and *O. palawana* (triangle).

### Variability

This species is variable in size (body length male 28-32 mm), but one male is extremely small (body length of 21.5 mm). Apart from its size this specimen differs from the specimens of *ida* described above in the absence of the distinct, ear-shaped basal pygofer lobes. The specimen is in the collection of NMW and bears the following label data: Bukit Monkobo, 5°48'N 116°58'E, 900 m, 13.viii.1987, A.H. Kirk-Spriggs, light trap sample, base camp, stunted hill forest, NMW Sabah (Borneo) Expedition, NMW.Z. 1987.094.

Material examined. — 92♂ 16♀. MALAYSIA: PENINSULAR MALAYSIA: PAHANG: Jengka, Bandar Tun Razak, 10-14.iii.1993, Ruslan, 1♂ (UKM). — SABAH: K. Belud, Sayap, 1.viii.1992, C. L. Wong, 1♀ (UKM); K. Belud, Sayap, 13-17.vii.1996, Nordin Wahid, 1♂ (UMS); K. Kinabalu, Bukit Padang, 50 m, 7.ix.1988, Zainab, 1♂ (UKM); Kota Kinabalu, Bukit Padang, UKMS, 50m, 10.vii.1983, Kusuadi, 00260, 1♀ (UKM); Mount Kinabalu, x.1978, Michel Duranton, 1♀ (MNP); Mt. Kinabalu, Waterstradt, 1♂ (BMNH); Gunung Kinabalu, Sayap, 3-8.vi.1992, Zaidi, Ismail, Ruslan, 13♂ 7♀ (UKM); Gunung Kinabalu, Sayap, 9.v.1992, Zaidi, Nordin, 1♀ (UKM); Taman Negara, Poring, 6-10.xii.1990, Zaidi, Ismail, Ruslan, 1♂ (UKM); Sipitang, Mondolong, 550 m, 22.viii.1988, Kushairi Idris, 1♂ (UKM); Tawau, Taman Bukit Tawau, 1-13.v.1992, Ruslan, 1♀ (UKM). — SARAWAK: Belaga, 9.viii.1983, M. Heldgaard, 1♂ (UZMK); Julau, Lanjak Entimau, 28-29.ii.92, Zaidi, 1♂

(UKM); Kedurong Lighthouse, ix.1910, Distant Coll. 1911-383, (BMNH); Kedurong, 1910, J.C. Moulton, 1911-141, 1♂ (BMNH); Matang, 450-894 m, 15.ix.1958, J.L. Gressitt & T.C. Maa, 1♂ (BPBM); Gunung Matang, 120 m, 12.ix.1958, T. C. Maa, 1♀ (BPBM); Gunung Mulu Nat. Park, Site 1, Camp 4, 452463, 1790 m, Lower montane (moss) forest, MV-Canopy, January, J.D. Holloway, RGS Mulu exp., B.M. 1978-206, 4♂, same data but Site 14, Camp 2.5, Mulu, 413461, 1000 m, Lower l. montane forest, February, MV - canopy / understorey, 2♂, Site 16, Long Pala (Base), 324450, 70 m, Allu./second. forest, MV-on batu-Canopy, March, 2♂ 1♀, Site 23, W. Melinau Gorge, 430558, 250 m, FEG 4, limestone forest, April, MV - canopy / understorey, 3♂ Site 25, G. Api, 427550, 900 m, lower montane forest, MV and Act., 2♂, Site 26, G. Api, Pinnacles, 428525, 1200 m, open scrub, MV, 2♂, Site 27, G. Api, Pandanus Camp, 429541, 1500 m, Scrub Pandanus Act., April, 2♂ (BMNH), Site 20, W. Melinau Gorge, 422577, 150 m, FEG 3, Kerangas, Mar.-Apr., MV - understorey, 1♂ (ZMA); Mt. Dulit, 4000 ft, moss forest, 14.x.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 3♂, same data but 26.ix.1932, 1♂, sheet (light), 5.x.1932, 1♂, 18.x.1932, 1♂, 21.x.1932, 7♂, at light, in house, light trap, 24.x.1932, 3♂, light traps, 25.x.1932, 1♂ (BMNH); Mt. Dulit, 4000 ft, moss forest, 17.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, T.H. Harrisson, B.M. 1933-254, 1♂, same data but 26.ix.1932, 2♂, 28.ix.1932, 1♂ (BMNH); Mt. Dulit, 4000 ft, moss forest, 2.ix.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, T.H. Harrisson, 8.0-9.30 P.M., rainy & cold, at light in house, B.M. 1933-254, 10♂ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok,

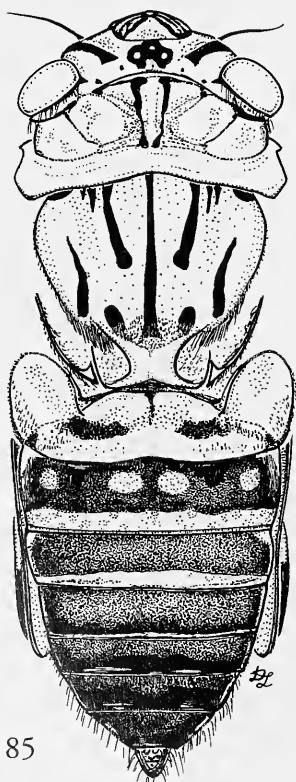
4.x.1932, traps & light, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 1♂ (BMNH). – BRUNEI: Bukit Pagon, LP 308, upper montane forest, 5520', 15-20.ii.1982, G.S. Robinson, BM 1982-156, 4♂ (BMNH); Bukit Pagon, montane forest, 1670 m, ii.1982, Allen & Harman, G.S. Robinson, BM 1982-156, 3♂ (BMNH); Temburong district, ridge NE of Kuala Belalong, approx. 300 m alt., x.1992, J.H. Martin coll., 125 m.v. light, B.M. 1992-172, 3♂ (BMNH) 1♂ (ZMA). – INDONESIA: KALIMANTAN: Boentok, Barito Riv., G.C. Shortridge, 1910-123, 1♂ (BMNH); Liang Koeboeng grot [= cave], 3.1894, Büttikofer, 1♀ (RMNH); Long Nawang, leg. Mjöberg, 1925, 4♂ (ZMA); Long Bagun, 25 km SE of Longboh, S. Mahakam, 7.iv.1996, R. Sözer, 1♂, same data but 21.xii.1995, 1♂ (ZMA); Tiong Buu (= Nahabuan), 18 km NW of Longkay, S. Mahakam, 15.iv.1996, R. Sözer, 1♂ (ZMA).

***Orientopsaltria palawana* sp. n.**  
(figs. 84-86, 89, 100, plate 4: 3)

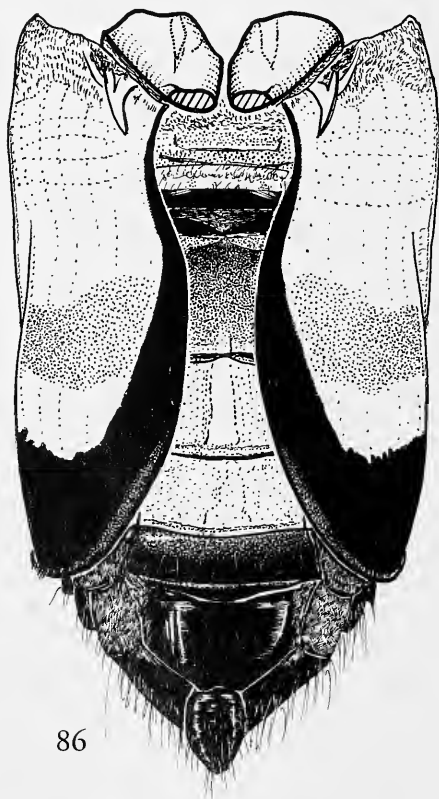
Type material. – 4♂ 10♀. Holotype ♂: 'Philippines, Palawan / Matalingajan / Pinigisan 600 meter /

5 Sept. 1961 / Noona Dan Exp. 61-62' (UZMK). – Paratypes: same data as holotype but: 3.ix.1961, 19.00-24.00, 1♀, 6.ix.1961, 20.00-03.15, 1♀, 8.ix.1961, 23.15-05.00, 1♂ 1♀, 9.ix.1961, 18.00-06.00, 1♂, 10.ix.1961, 2♀, 13.ix.1961, 2♀, 22.ix.1961, 20.30-23.00, 1♀ (UZMK), 8.ix.1961, 23.15-05.00, 1♂ 1♀ (ZMA); Palawan, Brooke's Pt., Macagua, 75 m, 7.iv.1962, M. Thompson collector Bishop, 1♀ (BPBM).

This species seems to be an endemic of the island of Palawan (fig. 84). At first sight *O. palawana* is fairly similar to *Orientopsaltria ida* from Borneo, due to unspotted tegmina and the fairly narrow lines on pronotum and mesonotum. However, *O. palawana* can easily be distinguished from *O. ida* by the larger trefoil-shaped spot on the head, the somewhat more conspicuous thorax marking, and especially by the distinct transverse brown fascia at half-length of the male operculum (fig. 86), which is absent in *ida* (fig.



85



86

Figs. 85, 86. *Orientopsaltria palawana*, holotype, Palawan, Matalingajan, Pinigisan. – 85, body in dorsal view; 86, abdomen with opercula in ventral view.

81); the females can be distinguished by the 9th abdominal segment that is very long in *ida*, and of normal size in *palawana*.

### Description

Ground colour of head and thorax brownish, pronotum with greenish tinge, abdomen somewhat darker brown than head and thorax.

**Head.** – Head from dorsal aspect with large, median trefoil shaped black mark that encloses the ocelli and extends to frontoclypeal suture; the black mark is broadly attached to the frontoclypeal suture. Supra-antennal plate with triangular, black mark. Fairly broad fasciae run from anterior margins of vertex lobes, more or less parallel to inner margins of eyes, and end halfway between lateral ocelli and eyes. A pair of very small brown to black dots is situated halfway between proximal ends of these fasciae and anterior margin of pronotum. Another pair of black spots is situated at posterior margin of head, close to the eyes. Anterior part of postclypeus with 7-9 transverse black to brownish black lines on either side, median ends of these lines connected by a line forming a median oval figure on anterior part of postclypeus. Genae black coloured along anteclypeus. Rostrum with black or black-brown apex reaching to halfway or to posterior margins of hind coxae.

**Thorax.** – Pronotum. Paired central fasciae very narrow, black, and slightly diverging from anterior margin of pronotal collar to anterior margin of pronotum; proximal ends widened just in front of anterior ridge of pronotum, distal ends also slightly widened and often rounded. Anterior ends of posterior oblique fissures with pair of black triangles that continue in a black line along lateral part of anterior pronotum margin, just behind the eye. Posterior margin of pronotal collar black.

**Mesonotum.** – Five narrow black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation, widened slightly at half-length to maximally  $3\times$  its anterior width, and posterior part slightly narrowed toward cruciform elevation. Paramedian fasciae slightly converging from anterior margin of mesonotum to half-length of mesonotum, as wide as or twice as wide as anterior part of median fascia. A pair of round spots in front of anterior angles of cruciform elevation. Lateral fasciae reaching from three fifths of mesonotum length from base to nearly posterior margin of mesonotum. These fasciae are very narrow anteriorly but often strongly widen distally; width of distal part as wide as or slightly broader than broadest part of median fascia, and one third to one fourth as wide as distance between paramedian and lateral fasciae.

**Legs.** – Fore femora with two fairly broad, light brown fasciae on upperside, and a light brown fascia

on outside; underside with brown to blackish line connecting the two spines. Distal halves of middle and hind tibiae dark brown.

**Tegmina and wings.** – Hyaline. Tegmina with light brownish suffusion and without spots. Basal half of venation of tegmina and wings reddish brownish, apical venation dark brown.

### Male

**Operculum** (figs. 86, 89). – Elongate but fairly broad, reaching to half-length or almost posterior margin of abdominal segment 6. Medial margin evenly convex. Lateral margin weakly convex in basal third or fourth, weakly concave at about one fourth of its length from base, and weakly convex in apical three fourths up to fairly broadly rounded apex. Medial margin with black-brown coloration that widens gradually from one fifth of its length from base to the black-brown coloured apical one fourth of operculum; however, most apical marginal area of operculum whitish. Lateral rim of operculum black-brown with exception of the most basal part. A broad transverse light castaneous fascia just below half-length the operculum separates the basal brownish green coloured part of the operculum from the yellow part between the transverse fascia and the apical black-brown part.

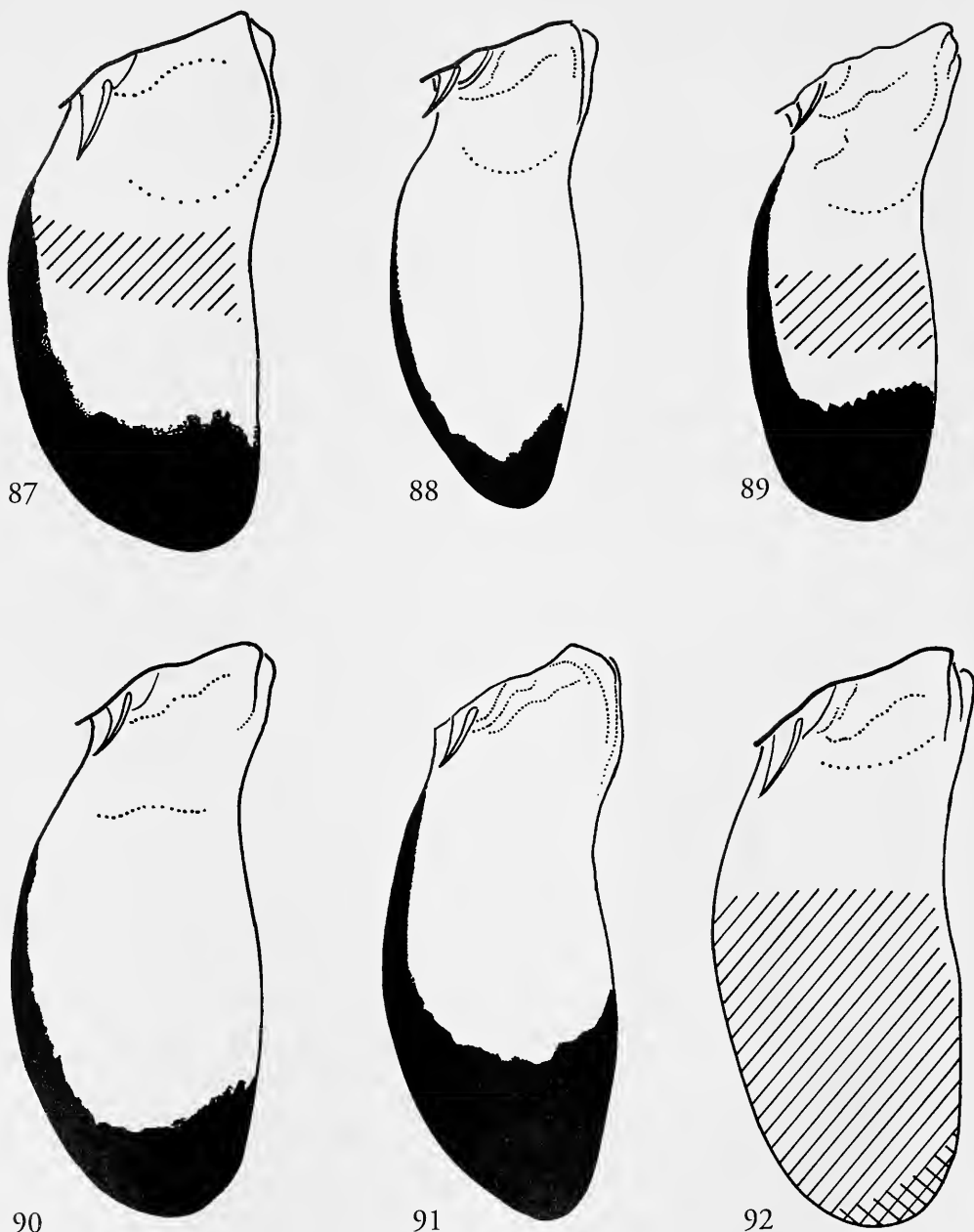
**Abdomen.** – Dorsal side brownish without marking, timbal coverings somewhat lighter than tergites, ventral side brown, posterior margin of 7th sternite dark brown.

**Genitalia** (fig. 83). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with fairly narrow outcurved ridges. Uncus with fairly large and globose basal part. Uncus lobe pointing latero-proximally with strongly developed straight lateral spine reaching just beyond lateral margin of pygofer, and a medial, short and fairly broad, weakly curved hook; lateral margin of uncus lobe concave to apex of lateral spine. Ridge between uncus lobes over apex of aedeagus fairly strongly elevated and straight.

### Female

**Operculum** (fig. 100). – Ochraceous, reaching to one fourth of length of abdominal segment 3. Lateral margin weakly undulate to the very slightly protruded or rectangular laterodistal angle of the operculum. Posterior margin almost straight or very weakly undulate but medially strongly convexly curved toward the meracanthus.

**Abdomen.** – Dorsally light brown, with somewhat darker brown transverse fasciae covering anterior half to two-thirds of the segments 3-7, and further with small dark brown lateral spots on the segments 3-7, and with a narrow median dark line and a pair of triangular dark spots attached to the anterior margin of



Figs. 87-92. Male opercula of *Orientopsaltria* species in lateroventral view. – 87, *O. hollowayi*, male holotype, Sarawak, Gunung Api; 88, *O. ida*, Brunei, ridge NE of Kuala Belalong; 89, *O. palawana*, holotype, Palawan, Matalingajan, Pinigisan; 90, *O. sumatrana*, Sumatra, Aceh, Mt. Leuser; 91, *O. vanbreei*, holotype, Peninsular Malaysia, Pahang, Jerantut; 92. *O. kinabaluana*, holotype, Sabah, 24 km on road Keningau-Kimanis.

segment 9. Ventrally light brown with black-brown coloration along posterior margins of sternites 3-6 and along lower margin of segment 9, and a narrow median dark brown line on sternite 7. Dorsal side and lateral parts of ventral side with scattered silvery pilosity.

Measurements (n= 4♂ 6♀). – Body length ♂ 29-31.5 mm, ♀ 22.5-26 mm; head width ♂ 9.8-10.1 mm, ♀ 9.0-9.8 mm; pronotum width ♂ 9.6-10.3 mm, ♀ 8.9-10.0 mm; tegmen length ♂ 39.5-42 mm, ♀ 36-39.5 mm.

### *Orientopsaltria sumatrana* group

#### Diagnosis

The *sumatrana* group contains two medium-sized to fairly large species (body length male: 30-34.5 mm): *O. sumatrana* and *O. vanbreei*. *O. sumatrana* is an endemic of Sumatra, while *vanbreei* has a wider distribution in the Malayan Peninsula, Sumatra, and

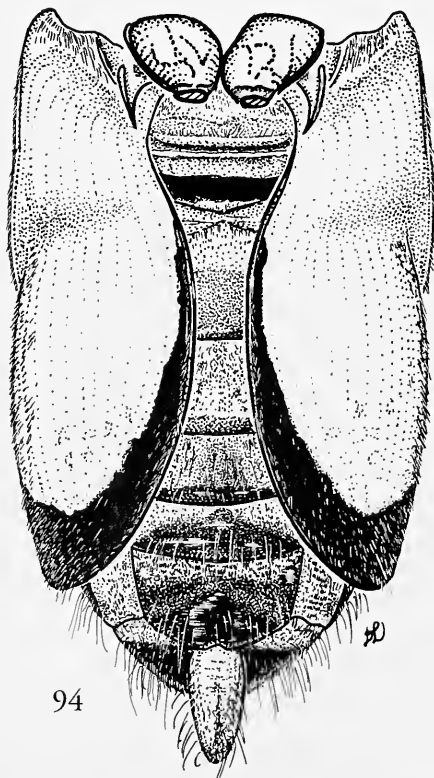
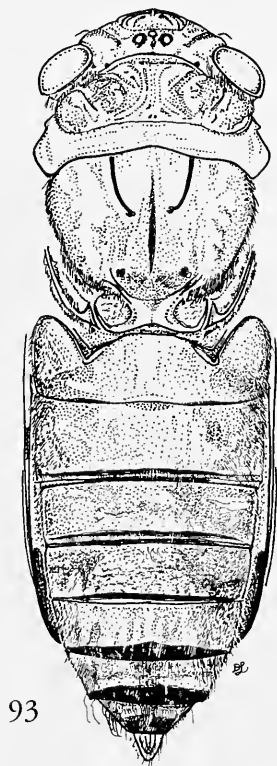
Borneo (fig. 97). The two species of this group have unspotted tegmina, a character that is also found in the *ida* group. The species of the *sumatrana* group are characterized by long, narrow and parallel sided uncus lobes (figs. 95, 96).

### *Orientopsaltria sumatrana* (Moulton, 1917) (figs. 90, 93-95, 97, 101, plate 4: 4)

*Cosmopsaltria sumatrana* Moulton, 1917: 2. ♂ holotype: Sandaran Agong, Korinchi, 2450 ft, RvK, 1916-229, *Cosmopsaltria sumatrana*, Moulton sp. n. 1 ♂, J.C. Moulton, 2/9/14, Type H. T. (BMNH) [examined].

*Cosmopsaltria sumatrana*; Moulton 1919: 63; Moulton 1923: 87, 91, 167, pl. 2 figs. 4, 4a-b; Metcalf 1963: 555. *Orientopsaltria sumatrana*; Duffels 1983: 10; Duffels & Zaidi 1998: 321.

*O. sumatrana* is a brownish, medium-sized species with very narrow lines on the mesonotum (fig. 93), unspotted tegmina, yellow opercula with fairly nar-



Figs. 93, 94. *Orientopsaltria sumatrana*, male, Sumatra, Aceh, Mt. Leuser. – 93, body in dorsal view; 94, abdomen with opercula in ventral view.

row black-brown coloration along medial and apical margins (fig. 94), and very long curved uncus lobes (fig. 95). *O. sumatrana* is fairly similar to *O. ida* in coloration and body marking but the males can easily be distinguished by the width of the black fascia along the margin of the operculum (figs. 90, 88) and a very different male uncus (figs. 95, 82). The relationships of *O. sumatrana* to the other species of the genus, and particularly to *O. vanbreei*, will be discussed under the latter species.

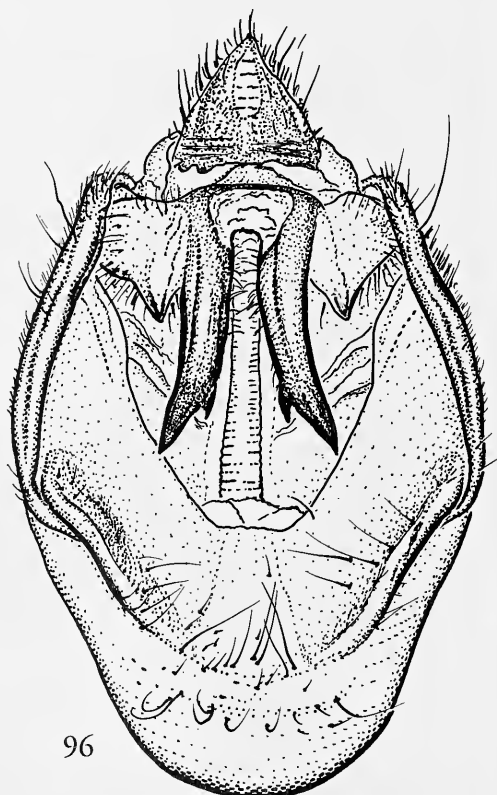
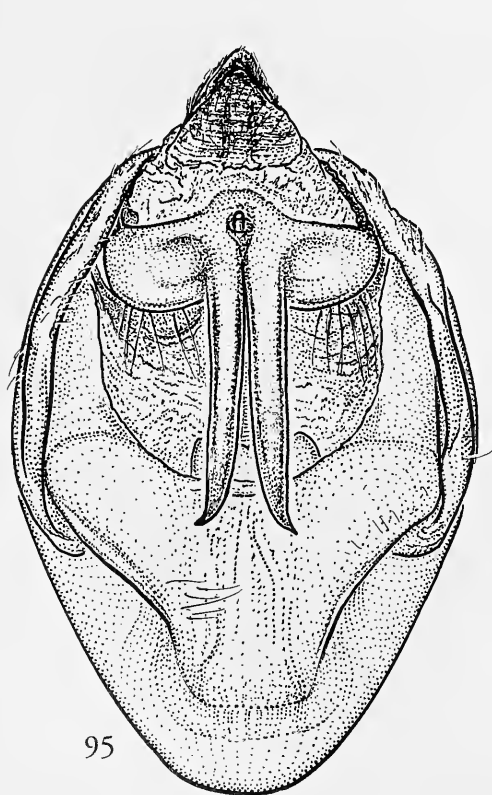
*O. sumatrana* was up to now known from only one specimen, collected at 350 m in Sandaran Agong, Korinchi Lake, Sumatra Barat. The present revision includes two more males and one female of this species, collected at 800 m in Mount Leuser National Park in Aceh, Sumatra Utara. At this moment *O. sumatrana* is only known from Sumatra (fig. 97). The closely related *O. vanbreei* has a wider distribution, below 350 m, in Negeri Sembilan and Pahang in Peninsular Malaysia, in Sumatra Utara, and in Sarawak, Borneo.

## Description

Ground colour of head and thorax brownish, pronotal collar with a light greenish tinge, abdomen dorsally brownish, and ventrally darker brown.

Head. – Head from dorsal aspect with black ring around each of paired ocelli, and small black triangle around median ocellus; black coloration around each of the ocelli not fused. A pair of very small dark brown spots between paired ocelli and eyes. Anterior margins of supra-antennal plates and vertex lobes with dark brown stripe. Anterior part of postclypeus with 7–8 transverse black lines on either side, median ends of some of these lines connected by a line forming a median oblong figure, which is not closed at both ends, on anterior part of postclypeus. Genae black coloured along anteclypeus. Rostrum with black-brown apex just reaching anterior margin of hind coxae.

Thorax. – Pronotum. A pair of juxtaposed central spots situated at anterior margin of pronotal collar.



Figs. 95, 96. Male pygofer in ventral view. – 95, *Orientopsaltria sumatrana*, holotype, Sumatra, Sandaran Agong, Korinchi; 96, *Orientopsaltria vanbreei*, holotype, Peninsular Malaysia, Pahang, Jerantut.

Posterior margin of pronotal collar with very narrow black line.

**Mesonotum.** – The median fascia is extremely narrow or obsolete at anterior margin of mesonotum, widest, though still very narrow, at two fifths of its length from base, and slightly narrower toward cruciform elevation. Paramedian fasciae as wide as broadest part of median fascia and converging from anterior margin of mesonotum to half-length of mesonotum. A pair of small round spots in front of anterior angles of cruciform elevation. One male and one female have a lateral pair of short, dark brown stripes situated in direct line with anterior arms of cruciform elevation.

**Legs.** – Brownish. Fore femora with black-brown line connecting the spines along lower edge. Apical parts of tibiae of all legs dark brown to black. Tarsi of fore and middle legs dark brown to black.

**Tegmina and wings.** – Hyaline with faint brownish suffusion, and without spots. Tegmen with basal half of venation light brownish and apical venation dark brown, wing venation dark brown.

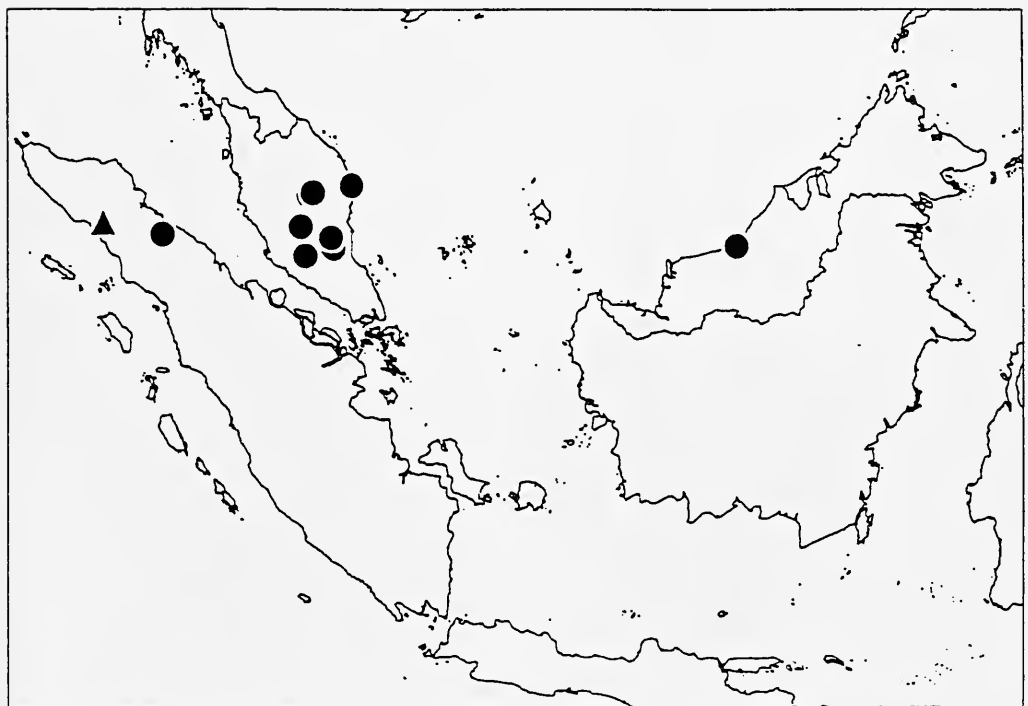
#### Male

Operculum (figs. 90, 94). – Elongate, fairly broad,

apical two thirds slightly outcurved, reaching nearly to anterior margin of abdominal segment 7 or to half-length this segment. Medial margin evenly convex. Lateral margin weakly convex at base, strongly concave at one third of its length from base, and weakly convex in apical two thirds. Operculum yellow or green with exception of a fairly narrow black-brown border along median margin widening from one third of operculum length from base distad to the fairly broad black-brown apical border of the operculum. Lateral, very narrow, rim of operculum black from base of operculum to the black-brown apical part.

**Abdomen.** – Dorsal side brownish without marking, posterior margins of tergites black-brown. Sternites 3-5 lightly coloured with posterior half of sternite 3, posterior one fifth of sternite 4, and posterior part of segment 5 dark brown. Undersides of segments 6-8 darker brown especially posteriorly; sternite 8 brownish.

**Genitalia** (fig. 95). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with narrow outcurved ridges. Uncus with a very narrow, not globose basal part. Uncus lobe with round swollen lateral part and a very long and narrow, api-



Figs. 97. Distribution of *Orientopsaltria sumatrana* (triangle) and *O. vanbreei* (rounds).

cally sharply pointed medial lobe, which is juxtaposed and runs parallel to median lobe of the other uncus lobe. An arcuate ridge between uncus lobes over apex of aedeagus cannot be distinguished.

### Female

Operculum (fig. 101). – Light brown, reaching to almost half-length of abdominal segment 3. Lateral margin somewhat oblique and very weakly undulate to the somewhat obtuse laterodistal corner of the operculum. Posterior margin straight to very weakly undulate but medially convexly curved toward meracanthus.

Abdomen. – Segment 9 very long, and ovipositor extending to far beyond the apex of segment 9. Abdomen dorsally dark brown with exception of the lighter brown segment 2, with scattered silvery pilosity, and a pair of very faint, paramedian, triangular dark spots at anterior margin of segment 9. Ventrally brown with black-brown coloration along posterior margins of sternites 3–6.

Measurements ( $n = 3\sigma$  1♀). – Body length ♂ 30.5–34.5 mm, ♀ 31.5 mm; head width ♂ 9.8–10.5 mm, ♀ 10.2 mm; pronotum width ♂ 9.9–10.8 mm, ♀ 10.6 mm; tegmen length ♂ 38–41.5 mm, ♀ 38.5 mm.

Material examined. – 2♂ 1♀. INDONESIA, SUMATRA: Aceh: Mt. Leuser Nat. Pk, Ketambe Res. Strn., 2–6.ix.1989, ROM 893020, B. Hubley, D. C. Darling, uv/Hg vapour light beside Alas River, 350 m, 1♂ 1♀ (ROME) 1♂ (ZMA).

### *Orientopsaltria vanbreei* sp. n. (figs. 91, 96–99, 102, plate 5: 1)

*Orientopsaltria sumatrana*; Zaidi & Hamid 1996: 49, 50, 53, 56, 57; Zaidi 1997: 109, 112–114.

*Orientopsaltria* sp. n. 2 (near *sumatrana* (Moulton)); Zaidi & Ruslan 1995: 64, 65, 69

*Orientopsaltria* near *sumatrana*; Zaidi et al. 1996: 61.

Type material. – 33♂ 41♀. Holotype ♂: 'MALAYSIA / Pahang / JERANTUT / 100 m. 9-X-1982, P.J.H. v. Bree' (ZMA). – Paratypes: MALAYSIA: PENINSULAR MALAYSIA: PAHANG: Bukit Ibam, 90 km WNW of Kuala Rompin, ca. 50 m, 4–9.x.1961, K.J. Kucheria, 1♀ (BPBM); Bukit Rengit, Lancang, 18–20.xii.1992, Zaidi & Abidi, 2♂ 9♀ (UKM) 1♂ (BMNH); Bukit Rengit, 24–27.i.1992, Zaidi, Ismail, Zabidi, 1♀ (UKM); Taman Negara, Kuala Kenyam, 29–31.viii.1995, Zaidi, Ruslan & M'dir, 2♂ 1♀ (UKM); Taman Negara, Lata Berkoh, 30.ix.1995, Zaidi, Ruslan, M'dir, 4♂ 1♀ (UKM); T. Cini, 26.ii.1992, Badrol & Ahsan, 2♀ (UKM); K. Lompat, 19–21.viii.1990, Zaidi & Ruslan, 1♂ (UKM); Kuala Lompat, 25–27.viii.90, Ismail & Zabidi, 1♂ (UKM); Kuala Lompat, 27.viii.1992, Ruslan, Yusof, 1♂;

NEGERI SEMBILAN: Pasoh, 28.x.1991, Zaidi, Ruslan, Abin, 6♂ 12♀ (UKM); Pasoh, Hutan FRIM, 20–22.i.1995, Ruslan, Ismail, 1♂ 2♀ (UKM); Pasoh Forest Reserve, station quarters, 10 km W Ayer Hitam, 350 m, 9.xii.1996, at light houses, M. Kos & S. Azman, 1♀, same data but 3.xii.1996, 1♀, 5.xii.1996, 1♂, 10.xii.1996, 2♀, 11.xii.1996, 1♂ 1♀, 14.i.1997, 1♀, 4.xii.1996, at light arboretum, 1♀ (ZMA), 11.xii.1996, 1♀ (UKM); Pasoh Forest Reserve, 2.2 km NNE station quarters, 10 km W Ayer Hitam, 350 m, 10.xii.1996, at light, M. Kos & S. Azman, 3♀ (ZMA); Pasoh Forest Reserve, 0.9 km ENE station quarters, 10 km W Ayer Hitam, 350 m, 6.xii.1996, at light, M. Kos, trail between primary forest and buffer zone, 1♀ (UKM). – SARAWAK: Bintulu, Kampus UPM, 10.iii.1992, Zaidi, 2♂ (UKM). – INDONESIA, SUMATRA: Deli, L.P. de Bussy, ex alcohol, 12♂ (ZMA).

One specimen of this beautifully coloured species was collected in 1982 by our esteemed colleague Dr P. J. H. van Bree. In later years more specimens were collected at several occasions in Pahang and Negeri Sembilan in Peninsular Malaysia (Zaidi & Ruslan 1995) and in Sarawak, Borneo (Zaidi & Hamid 1996, Zaidi 1997) during the surveys of cicada biodiversity of Malaysia by the Centre for Insect Systematics of the Universiti Kebangsaan, Malaysia. In 1996 the species was collected again in a large number, in the Pasoh Forest Reserve (Negeri Sembilan), by Martijn Kos of the University of Amsterdam, and S. Azman of the Universiti Kebangsaan Malaysia. Study of other material from museum collections only revealed some old material from Deli [area around Medan], Sumatra Utara. These data show that this new species occurs in Sarawak, Borneo, in Sumatra Utara, Indonesia, and in Pahang and Negeri Sembilan, Peninsular Malaysia (fig. 97).

*O. vanbreei* and *O. sumatrana* share the same structure in male uncus (figs. 95, 96) and are therefore supposed to be sister species. The two species can be separated from most other species of *Orientopsaltria* by their unspotted tegmina and a weakly developed marking on the thorax (figs. 93, 98). The two species are easily distinguished by the colour of the body: brown in *sumatrana* (fig. 93), and beautifully green with black and brown, and a pair of conspicuous lateral white waxy marks on segment 3 of the male abdomen in *vanbreei* (fig. 98). Initially we presumed that the dull brown colour of the holotype of *sumatrana* was due to the poor preservation of the specimen, but three recently collected specimens of this species showed that brown is probably the natural body colour of this species. The black coloration along the median margin of the male operculum is considerably wider in *vanbreei* (fig. 91) than in *suma-*

*trana* (fig. 90), and the shape of the uncus of the two species differs (figs. 95, 96). The *ida* group contains two species: *O. ida* and *O. palawana*. *O. palawana* of the *ida* group can easily be separated from *O. vanbreei*, *O. sumatrana*, and *O. ida* by its distinct transverse fascia at half-length of the male operculum.

### Description

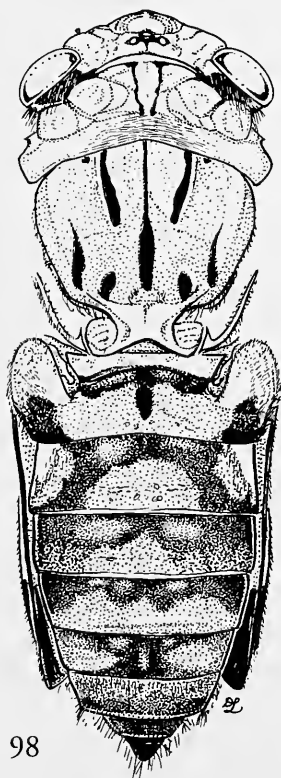
Ground colour green with brownish tinge, material from Sumatra, Deli dull brownish due to preservation in alcohol.

Head. – Head from dorsal aspect with median trefoil shaped black-brown mark that just encloses the ocelli; this mark usually extends distad to frontoclypeal suture. Supra-antennal plate with triangular, brownish mark. Vertex lobe with brownish streak. Anterior part of postclypeus with 5-10 transverse brownish lines on either side, the median ends of the upper 5-6 lines connected by a line forming a median oval figure on the anterior part of the postclypeus.

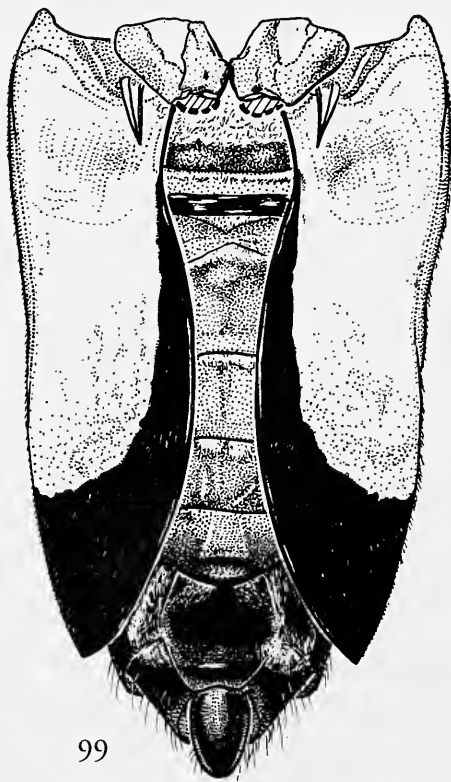
Rostrum with black-brown apex reaching just beyond anterior margin of hind coxae.

Thorax. – Pronotum. Paired central fasciae very narrow, black, mostly uninterrupted but sometimes reduced to a few lines or spots. Fasciae slightly diverging from anterior margin of pronotal collar to anterior margin of pronotum; proximal ends juxtaposed or connected but always somewhat widened, distal ends also widened but not connected. Posterior margin of pronotum black.

Mesonotum. – Five narrow black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation; this fascia is anteriorly very narrow, widens to 5-6 $\times$  its anterior width between three fifths to two fifths of its length from base, and narrows slightly toward cruciform elevation. Paramedian fasciae slightly converging from anterior margin of mesonotum to half-length of mesonotum, anterior parts of these fasciae slightly wider to 3 $\times$  as wide as anterior part of median fascia, and distal parts twice as



98



99

Figs. 98, 99. *Orientopsaltria vanbreei*, holotype, Peninsular Malaysia, Pahang, Jerantut. – 98, body in dorsal view; 99, abdomen with opercula in ventral view.

wide as anterior parts. Distance between median and paramedian fasciae at most  $4\times$  and at least twice as wide as the broadest part of the paramedian fascia. A pair of small round spots in front of anterior angles of cruciform elevation. Lateral fasciae very short, reaching from half-length or two fifths of mesonotum length from base to nearly posterior margin of mesonotum, fasciae almost as wide as broadest part of median fascia, and one fourth to one sixth as wide as distance between paramedian and lateral fasciae.

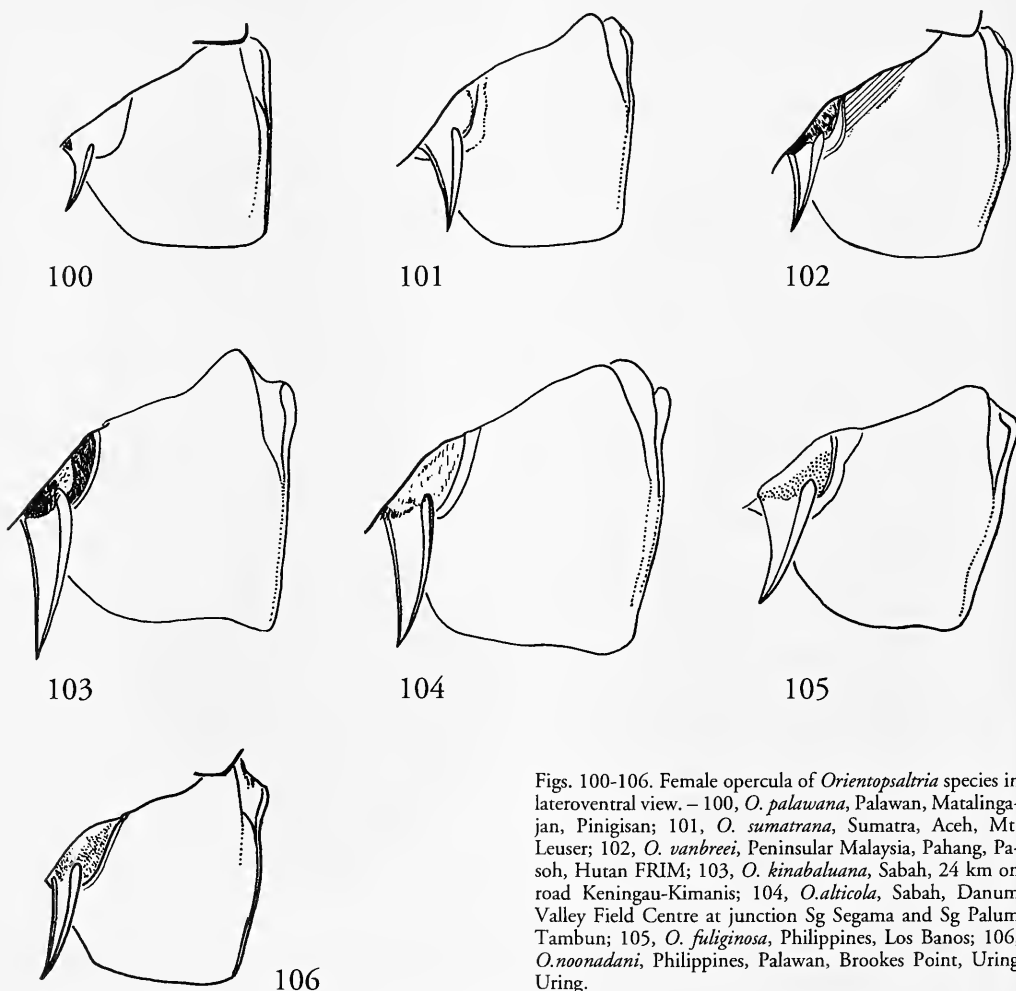
Legs. – Fore femora with faint light brown fasciae on upper- and innersides, and with a black-brown line connecting the spines along lower edge. Middle and hind femora with respectively a fairly broad and a very broad brown fascia on posterior sides. Fore tibiae distally black-brown, with a broad black fascia on

outside. Middle and hind tibiae with distal one sixth to one third black-brown. Tarsi of fore and middle legs dark brown to black.

Tegmina and wings. – Hyaline with light brownish suffusion, and without spots. Venation of tegmen and wing brownish in basal third, turning to dark brown more apically.

# Male

Operculum (figs. 91, 99). – Elongate, fairly broad and apical two thirds slightly outcurved, reaching to half-length abdominal segment 7 or to nearly posterior margin of this segment. Medial margin evenly convex. Lateral margin weakly convex at base, strongly concave at one third of its length from base, and weakly convex in apical two thirds. Lateral, very nar-



Figs. 100-106. Female opercula of *Orientopsaltria* species in lateroventral view. – 100, *O. palawana*, Palawan, Matalingajan, Pinigisan; 101, *O. sumatrana*, Sumatra, Aceh, Mt. Leuser; 102, *O. vanbreei*, Peninsular Malaysia, Pahang, Pasoh, Hutan FRIM; 103, *O. kinabaluana*, Sabah, 24 km on road Keningau-Kimanis; 104, *O. alticola*, Sabah, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun; 105, *O. fuliginosa*, Philippines, Los Banos; 106, *O. noonadani*, Philippines, Palawan, Brookes Point, Uring Uring.

row, rim of operculum black from base of operculum to the black-brown apical part. Operculum yellow or green with exception of a fairly narrow black-brown border along the median margin widening to the black-brown apical fourth of the operculum.

Abdomen. – Dorsal side with conspicuous black to brown marking. Anterior margin of segment 2 black bordered and with a narrow, mediodorsal, black mark reaching to half-length the segment. A distinct black mark covers the basal third of the timbal covering and the adjacent most lateral part of segment 2. A conspicuous patch of white wax with silvery hairs is situated on segment 3 just posterior to black mark of segment 2; the white patch reaches from anterior segment margin along two thirds or three fourths of segment length, and is a little broader than long. Black coloured border along anterior margin of segment 3, between the white patches, reaching to one third or two fifths of segment length, and continuing along medial and distal sides of white patches. Black coloured border along anterior margin of segment 4 reaching medially to one third or two fifths of segment length, and covering laterally almost the whole surface of the segment. Black coloured border along anterior margin of segments 5 weakly bilobate medio-distally, and reaching medially to one third or half of segment length and covering laterally the anterior two thirds of the segment. Segment 6 and 7 black or black and brownish. Ventral side of abdomen proximally greenish brown and turning to black-brown from segment 4 to the posterior.

Genitalia (fig. 96). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with fairly broad outcurved ridges. Uncus with a very narrow, not globose basal part. Uncus lobe in ventral view with stout and short lateral spine and a fairly long stout and apically sharply pointed medial lobe, which is outcurved and distinctly apart from the medial lobe of the other uncus lobe; apical part of medial lobe distinctly bifurcate. Narrow arcuate ridge between uncus lobes over apex of aedeagus weakly elevated and laterally incurved.

## Female

Operculum (fig. 102). – Light brown with greenish tinge, reaching to almost half-length of abdominal segment 3. Lateral margin fairly strongly undulate to the somewhat obtuse laterodistal corner of the operculum. Posterior margin weakly convex, but strongly convexly curved toward meracanthus.

Abdomen. – Dorsally with segment 2 and anterior half to one third of segments 3-8 dark brown, and posterior parts of segments 3-8 lighter brown sometimes with a greenish tinge, and with scattered silvery pilosity. Ventrally brownish with darker brown coloration along posterior margins of sternites 3-6. Ster-

nite 7 with median fascia, posterior margin of sternite and a pair of paramedian spots dark brown to black. Segment 9 light brown with lower and apical margins dark brown to black.

Measurements (n= 5♂ 6♀). – Body length ♂ 30-34 mm, ♀ 23.5-30 mm; head width ♂ 9.8-11.0 mm, ♀ 8.7-10.7 mm; pronotum width ♂ 10.2-11.5 mm, ♀ 8.8-11.1 mm; tegmen length ♂ 39.5-44 mm, ♀ 35.5-43 mm.

## *Orientopsaltria kinabaluana* group

### Diagnosis

The *kinabaluana* group contains only one fairly large-sized species (body length male: 33-36.5 mm), which is endemic to the Mt. Kinabalu area of Borneo. The species is very conspicuous by the characteristic marking of the mesonotum, the shape and colour of the male operculum, and the colour of timbal coverings (figs. 107, 108). *O. kinabaluana* forms the alleged sister group of the *alticola* group. The apex of the uncus is rounded in this species, and oblique in the *alticola* group, but the short lateral spine of the uncus is regarded homologous with the short subapical spine found in the *alticola* group.

### *Orientopsaltria kinabaluana* sp. n.

(figs. 92, 103, 107-110, plate 5: 2)

Type material. – 21♂ 16♀. Holotype ♂: 'RMNH: N. Borneo, Sabah / 24 km on rd. Keningau - / Kimanis (N. side), 1350 m / 116°03'E 5°27'N, 19 Nov 1987 / a.l. J. Huisman & R. de Jong (RMNH).— Paratypes: MALAYSIA: SABAH: same data as holotype, 1♂ (ZMA) 1♀ (RMNH); Bukit Monkobo, 5°48'N 116°58'E, 1200 m, 18.viii.1987, A.H. Kirk-Spriggs, light trap sample, camp 1, stunted hill forest, NMW Sabah (Borneo) Expedition, NMW.Z. 1987.094, 2♂ (NMW) 1♂ (ZMA); Crockerange, 40 km S of Kota Kinabalu, Sinsuronrd, 1500 m, 18. 19. 20.xii.1989, A. L. J. Huisman, JB 8923, 24, 25, submont. oak forest, 1♂ (RMNH); Mount Kinabalu, x.1978, Michel Duranton, 4♂ 1♀ (MNP) 1♂ (ZMA); Mt. Kinabalu, 1500 m, 17.viii.1976, R. Yoshii leg., NSMT-I-He 4418, Natn. Sci. Mus. Tokyo: Loan No. He-97-017, 1♂ (NSMT); Kinabalu Nat. Park, Park Headquarter, 1500 m, 29.vi.1996, T. Trilar & K. Prosenc leg., 1♀ (PMS); Kundasang, Kinabalu Park H. Q., 1550 m, 19.xi.1981, Keiji Mbrishima, 00170, 1♂ (UKM); Mt. Kinabalu, Mesilau, 4.ii.1964, J. Smart, Royal Soc. Exped. B.M. 1964-250, 1♀ (BMNH); Mt. Kinabalu, Mesilau, 3.iv.1964, 5000 ft., Royal Soc. Exped. coll. S. Kueh, B.M. 1964-250, 1♂, same data but 29.iii.1964, 1♀, 4.iv.1964, 1♂ (BMNH); Gunung Kinabalu, Sayap, 9.v.1992, Zaidi, Nordin, 1♂ 6♀

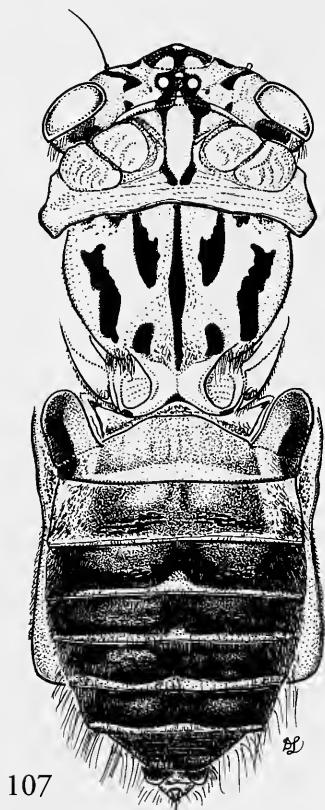
(UKM); Gunung Kinabalu, Sayap, 3-8.vi.1992, Zaidi, Ismail, Ruslan 3♂ 2♀ (UKM); Mt. Kinabalu, Tenompok, 2.ix.1958, Faunula of Bamboo Hut, Lot 6, T. C. Maa, 1♀ (BPBM); Tambunan, VJR Rafflesia, iv.1994, Ento Staff, 2♂ 1♀ (UKM); Borneo, 737, R. Mus. Hist. Nat. Belg. I. G. 13.409, 1♀ (KBIN);

This species is endemic to the Mt. Kinabalu area of Borneo (fig. 110). *O. kinabaluana* has some very characteristic features: the dark brown coloration of the laterobasal one third to half of the timbal covering, the strongly outcurved lateral fasciae on the mesonotum, the slightly outcurved male opercula, and the rounded uncus lobes with lateral indentation (fig. 109). The male opercula are brownish black in distal two thirds and provided with a greyish pilosity. Furthermore, *O. kinabaluana* has a distinct spot at the apex of cubital vein CuA1, but this character is also found in *O. hollowayi*.

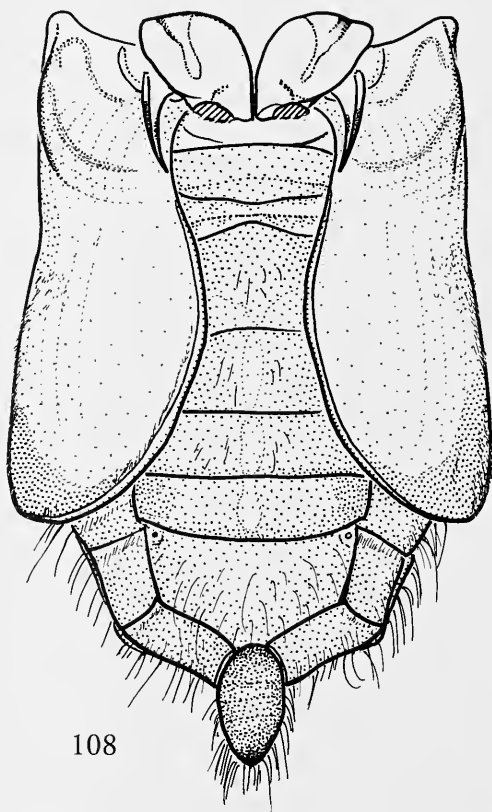
## Description

Body with shiny, light brown ground colour.

Head. – Head from dorsal aspect with large black mark, that encloses the ocelli, narrows distad to frontoclypeal suture and continues on the postclypeus in a fascia that is narrowest at half-length and extends to the median ground coloured oval spot at anterior margin of postclypeus; proximal margin of median black spot with two lobes sometimes reaching posterior margin of head. A short, fairly broad, black fascia runs from anterior margin of vertex lobe, parallel to the eye, to one third of vertex length from base; fascia about 3-4× as long as broad; distance between fascia and eyes equally broad to twice as broad as fascia width. Supra-antennal plate dorsally black-brown. Ventral side of vertex lobe with brownish to black-brown spot of very variable size halfway between antenna and eye; this spot is lacking in a few specimens. Anterior part of postclypeus with 5-6 transverse, dark



107



108

Figs. 107, 108. *Orientopsaltria kinabaluana*, holotype, Sabah, 24 km on road Keningau-Kimanis. – 107, body in dorsal view; 108, abdomen with opercula in ventral view.

brown to black, lines on either side, median ends of these lines connected by a line enclosing an oval spot of the ground colour. Remaining part of postclypeus unmarked, apical part of anteclypeus sometimes with brownish margin. Genae black coloured along anteclypeus. Rostrum brown to black-brown apically, extending just beyond hind coxae.

**Thorax.** — Pronotum. Paired central fasciae black, continuous or partly faded, slightly diverging distad, and each fascia widened at anterior pronotum margin; proximal one thirds of fasciae converging and fused at anterior margin of pronotal collar. Area between central fasciae yellow. Some specimens have a dark spot on the latero-proximal corner of the pronotal collar.

**Mesonotum.** — Five black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation. This fascia is anteriorly about one eighth as wide as distance between median and paramedian fascia, widens gradually from half-length to one third of mesonotum length from base, where it attains  $2\text{--}3\times$  its anterior width, and narrows again toward cruciform elevation. Paramedian fasciae slightly converging from anterior margin to half-length of mesonotum; the fascia is anteriorly as narrow as anterior part of median fascia, but gradually widens to  $3\times$  of the anterior width at half of their length; their apical halves are about as wide as distance to median fascia. A pair of round black spots in front of anterior angles of cruciform elevation about as wide as apical part of paramedian fasciae. Lateral fasciae extending from three fourth to two third of mesonotum length from base to the level of apices of anterior branches of cruciform elevation; some specimens have a small black mark in front of the lateral fascia at anterior mesonotal margin. Lateral fasciae strongly curved outwards to the anterior, and about  $4\text{--}6\times$  as long as broad and half as broad as distance to paramedian fasciae. A pair of black triangles at anterior mesonotal margin between paramedian and lateral fasciae.

**Legs.** — Fore femora somewhat darker brown than ground colour, underside with fairly broad, dark brown to black-brown fascia connecting the spines; hind femora with broad brown fasciae extending along whole length of femur. Distal one third or half of fore tibiae, distal one fifth of middle tibiae and distal one sixth of hind tibiae black-brown; hind tibiae with proximal dark mark. Tarsi of fore and middle legs black-brown.

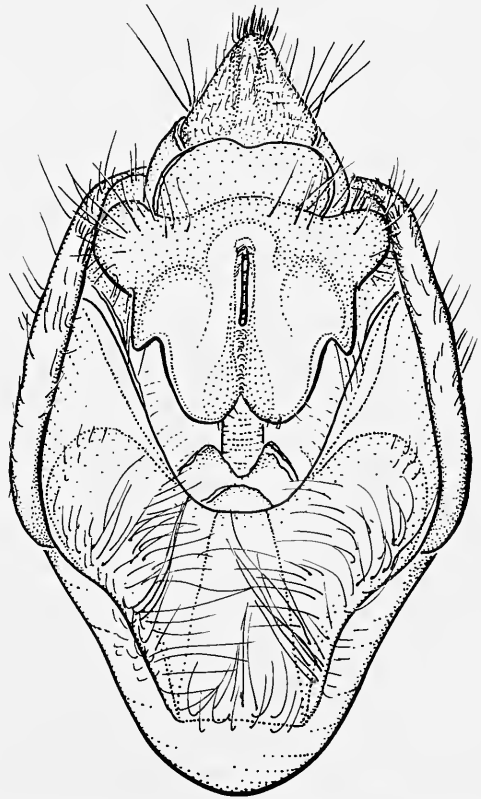
**Tegmina and wings.** — Tegmina with basal veins of 2nd, 3rd, 5th and 7th apical areas distinctly infuscated; infuscation at base of 7th apical area at least as large as that at the base of 2nd apical area; apices of longitudinal veins of apical areas 2-6 with small but distinct infuscations but infuscation at apex of cubital vein CuA1 distinctly larger than the other apical in-

fuscations; some specimens have a small infuscation at the apex of cubital vein CuA2. Venation of tegmen light brownish, venation of wing light to dark brown.

### Male

**Operculum** (figs. 92, 108). — Relatively short and slightly outcurved, reaching just beyond hind margin of abdominal segment 5 to half-length segment 7. Medial margin evenly convex. Lateral margin weakly convex in basal part, concavely sinuate at one third to one fourth of its length from base, and weakly convex in apical two thirds. Apical and lateral margins of operculum dark brown to black-brown. Basal one third of operculum light brown with very narrowly dark brown lateral rim, distal two thirds brownish black with greyish pilosity.

**Abdomen.** — Dorsally brown with black-brown marking and with greyish pilosity especially on lateral parts of segments 2-3 and medial parts of segments 5-7. Segment 2 with very faint median mark and transverse paramedian marks slightly darker than



Figs. 109. *Orientopsaltria kinabaluana*, male pygofer in ventral view, holotype, Sabah, 24 km on road Keningau-Kimanis.

ground colour. Timbal covering black-brown in laterobasal corner; dark coloration covering one third to half of timbal surface. Segment 3 with pair of paramedian transverse black-brown marks, about half as long as the segment and equally distant from anterior and posterior margins; segments 4-8 black-brown with exception of posterior margins of segments 4-7. Ventral surface of abdomen black-brown, but sternites 2-5 often lighter brown coloured.

Genitalia (fig. 109). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with narrow outcurved ridges. Uncus with fairly large, weakly globose, basal part. Uncus lobe broad with broadly rounded apices; lateral margin basally weakly concave, fairly strongly indented at half-length, and weakly convexly curved to the broad apex. Uncus with weakly elevated, laterally incurved ridge over apex of aedeagus.

### Female

Operculum (fig. 103). – Ochraceous, reaching to one third of length of abdominal segment 3; lateral margin either weakly undulate, or sinuate in basal one third and more or less straight to the slightly protruded laterodistal angle; distal margin undulate but medially strongly convexly curved toward meracanthus.

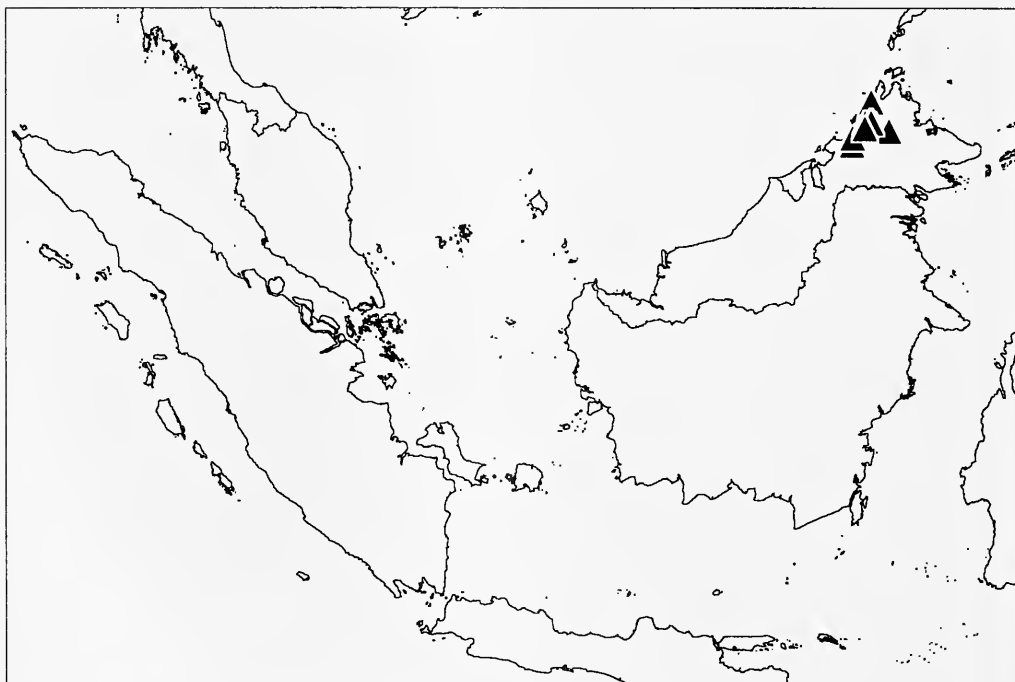
Abdomen. – Dorsally with anterior two thirds of segments 2-8 brown, posterior one third of these segments lighter brown, and segment 9 with a pair of indistinct, obconical dark marks at anterior segment margin. Dorsal side of abdomen covered with scattered silvery pilosity especially on lateral parts of segments; most conspicuous is the silver pilosity on the lateral part of segment 3. Ventral side of abdomen brown without distinct marking.

Measurements ( $n=5\sigma\ 5\varphi$ ). – Body length  $\sigma$  33-36.5 mm,  $\varphi$  30.5-37 mm; head width  $\sigma$  11.5-12.8 mm,  $\varphi$  11.8-13.1 mm; pronotum width  $\sigma$  12.0-13.1 mm,  $\varphi$  12.6-14.0 mm; tegmen length  $\sigma$  48.5-50.5 mm,  $\varphi$  50.5-52.5 mm.

### *Orientopsaltria alticola* group

#### Diagnosis

The *alticola* group contains six medium-sized to fairly large species (body length male: 27.5-43 mm): *O. alticola*, *O. fuliginosa*, *O. latispina*, *O. inermis*, *O. confluens*, and *O. noonadani*. The distribution of these species is given in figs. 114, 123, and 135. *O. alticola* has been recorded from the Malayan Peninsula and Borneo, *O. inermis* is an endemic of Min-



Figs. 110. Distribution of *Orientopsaltria kinabaluana*.

danao, Philippines, *O. confluentis* is only recorded from the small island Basilan between Mindanao and Borneo, *O. fuliginosa* is widespread in the Philippines from Luzon to Mindanao, while its close relative, *O. latispina*, is only found in Lubang Island, a small island west of the passage between Luzon and Mindoro, and finally *O. noonadani* is found on Palawan and the adjacent Busuanga and Balabac islands. The *alticola* group is characterized by the male operculum with a very narrow to broad area covered with white wax along the apical margin. All species of this group share a very similar, fairly broad uncus lobe, with oblique apical margins, short lateral spines, and parallel lateral margins with a short, subapical spine. The basal part of the uncus is small and weakly globose, while it is large and distinctly globose in the other species of the genus, except in the two species of the *sumatrana* group where it is very narrow, and flat.

### *Orientopsaltria alticola* (Distant, 1905)

(figs. 104, 111-114, 124, plate 5: 3)

*Cosmopsaltria alticola* Distant, 1905: 200. Holotype ♂: 'Kina Bal', 'Kina Balu 1903-188', 'Cosmopsaltria alticola Dist. type', 'Type' (round label; red circle) (BMNH) [examined].

*Cosmopsaltria alticola*; Distant 1906: 56; Moulton 1911a: 140; Moulton 1911b: 189, 190; Distant 1912: 44, pl. 5, figs. 36a, b, c; Moulton 1923: 88, 91-92; Metcalf 1963: 545; Nast 1972: 141; Duffels & Van der Laan 1985: 135.

*Orientopsaltria alticola*; Duffels 1983: 9; Zaidi & Ruslan 1995b: 197, 200, 203; Zaidi et al. 1996: 60; Duffels & Zaidi 1998: 321.

*Cosmopsaltria alticola* var. *pontianaka* Kirkaldy, 1913: 9; Moulton 1923: 91.

*Cosmopsaltria inermis* (nec Stål); Moulton 1911a: 140 (partim: Borneo); Moulton 1911b: 185 (partim: Borneo).

*Platylomia banqueyensis* Distant 1912: 48. Holotype ♂: 'Bangey', 'Borneo Sept., I. Banquey, coll. Noulhier 1898', 'Platylomia bangueyensis Dist., type', 'Type' (round label; red circle) (BMNH) [examined].

*Platylomia bangueyensis*; Moulton 1923: 100; Metcalf 1963: 614. **syn. n.**

*Orientopsaltria alticola* is fairly common in Sabah, Sarawak, Brunei and Kalimantan, and has long been regarded an endemic of Borneo, until recently one specimen was recorded from Peninsular Malaysia (Zaidi et al. 1996). The species can be separated from the other large species of *Orientopsaltria* from Borneo by the short typically coloured male operculum and by the absence of lateral mesonotal fasciae (figs. 111-112). A few specimens of *alticola* have a pair of short and narrow dark lateral streaks on the posterior part of the mesonotum, however. Only one other Bornean *Orientopsaltria* species, *O. ida*, occasionally has 3 instead of 5 fasciae on the mesonotum, but *O. ida* is much smaller than *O. alticola* and has unspotted tegmina.

### Identity and synonymy

*Cosmopsaltria alticola* was described from one male specimen from Mount Kinabalu, that is regarded as the holotype. In 1913 Kirkaldy described *alticola* var. *pontianaka* from Pontianak, Borneo. This variety should differ from Distant's typical *alticola* in one character: the presence of infusate spots near the apices of the apical veins of the tegmina. Moulton (1923) already mentioned that Distant (1905) omitted this character in the description of *alticola*, and that the marginal spots are present in the beautiful figure of *alticola* given by Distant in 'Genera Insectorum' (1912). Moulton (1923) placed Kirkaldy's variety in the synonymy of *C. alticola*.

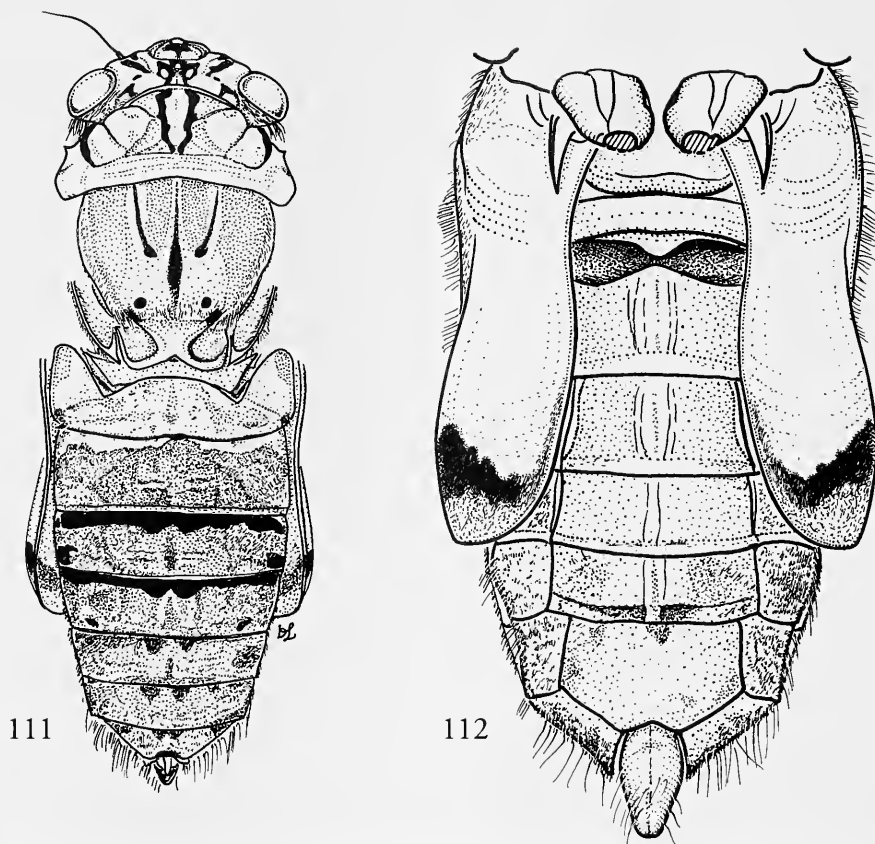
*Platylomia banqueyensis* Distant, 1912 has been described from Banggi Island north of Borneo. The holotype is an immature male with faint spots at the bases of the 2nd, 3rd, 5th and 7th apical areas and more or less uniformly brownish, crumpled opercula. *P. banqueyensis* is regarded a junior synonym of *O. alticola* because of the similar external features and male genitalia.

### Description

Ground colour brownish, head and pronotum sometimes with greenish tinge. Marking on head and thorax black and sometimes dark brown.

Head. – Dorsally with central black, trefoiled mark enclosing ocelli; trefoiled mark with fairly long lateral lobes and in by far most specimens connected with anterior pronotum margin by two central black lines; the trefoiled mark is broadly connected with the frontoclypeal suture, and in most specimens continues on the postclypeus in a black, sometimes dark brown, anchor-shaped mark just touching median ground coloured oval spot on anterior part of postclypeus. Anterior margin of supra-antennal plates with a small black to black-brown spot just above antenna. A pair of oblique, black and only occasionally brown, very broad to narrow fasciae extend from vertex lobes to the level of the paired ocelli; fasciae usually as wide as to one third as wide as distance between fascia and eye, but occasionally narrower. The oblique fasciae are sometimes proximally connected with a pair of small black spots situated medially of eyes against anterior margin of pronotum. Underside of vertex lobes with (fairly) broad black fascia running from antenna to eye. Anterior part of postclypeus with 5-6 transverse, black, lines on either side; 2-3 lines reaching supra-antennal plates, other lines shorter; medial ends of transverse lines connected and enclosing an oval spot of the ground colour. Ventral side of postclypeus with black to black-brown, medial mark at clypeal suture. Rostrum black-brown apically, and just reaching posterior margin of hind coxae.

Thorax. – Pronotum. Paired central fasciae black,



Figs. 111, 112. *Orientopsaltria alticola*, male, Sabah, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun. – 111, body in dorsal view; 112, abdomen with opercula in ventral view.

slightly diverging from pronotal collar to anterior margin of pronotum; fasciae are narrowest at one third of length of pronotal disk and gradually widen distad to their anterior ends. A large dark mark, behind the eye, against anterior part of ambient fissure continues occasionally as a narrow brown line in the lateral part of the ambient fissure. Lateral margin of pronotal collar at half-length with either a brownish to black-brown spot or a narrow triangle that continues in a very narrow, black line along the posterior margin of pronotal collar.

**Mesonotum.** – Three narrow, black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation; the fascia is very narrow or extremely thin in the anterior one third or half, widens strongly to about three-fifths of its length, and slightly narrows again toward cruciform elevation. Paramedian fasciae about half as wide as widest part of median fascia, and slightly converging from anterior

margin to about three-fifths of mesonotum length. A pair of small round black spots in front of cruciform elevation, and often a pair of black marks just behind these round spots at the end of anterior branches of cruciform elevation. Lateral fasciae absent in most specimens, though some specimens have black lateral stripes on the posterior part of mesonotum or a pair of small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae.

**Legs.** – Fore femora either with broad, black to black-brown, subapical ring, or with large subapical spots on inner- and outsides; line connecting the spines along lower edge, and anterior spine black to black-brown. Fore tibiae brown to black-brown with exception of upperside; middle and hind tibiae with distal one fifth to one third black-brown; hind tibiae also proximally with brown mark. Tarsi of fore and middle legs dark brown to black.

**Tegmina and wings.** – Tegmina hyaline, some-

times with yellowish brown suffusion; basal veins of 2nd, 3rd, 5th and 7th apical areas and apices of longitudinal veins of apical areas infuscated. Venation light to dark brown, costa greenish.

### Male

Operculum (figs. 112, 124). – Fairly short and fairly broad, reaching to half-length or posterior margin of abdominal segment 5. Medial margin evenly convex. Lateral margin convex in basal third, distinctly concave at one third or one fourth of its length from base, and fairly strongly convex to the broadly rounded apex. Lateral rim of operculum dark brown to black. An undulating dark brown fascia widens from two-thirds of medial margin of operculum to the posterior and crosses the operculum to the lateral margin, where it attains its greatest width. Apical marginal part of operculum covered with white wax.

Abdomen. – Yellowish with a greenish tinge. Ante-

rior margin and lateral part of segment 3 covered with white wax. Dorsal marking brown; tibial coverings with brown spot in laterobasal corner; segment 2 with narrow dark brown line along posterior margin; segments 2 and 3 with small median spot at anterior segment margins; segments 3-5 with a pair of small paramedian spots close to posterior segment margins; anterior margin of segment 4 with dark brown marking, which is medially weakly bicuspidate and strongly widens laterally; segment 5 with medially weakly bicuspidate, dark brown line; segments 6 and 7 with a pair of faint, light brown, paramedian triangles. Ventral side of abdomen unmarked, but in some specimens with transverse brown marking on segments 6 and 7.

Genitalia (fig. 113). – Lateral pygofer lobes with distinct upcurved protrusions. Basal pygofer lobes with narrow outcurved ridges. Uncus with small, weakly globose, basal part. Uncus lobes adjacent medially, medio-distal corners rounded, apical margin oblique weakly concave and ending laterally in a fairly narrow apex; lateral margins weakly concave with a blunt spine just above the apical spine. Narrow arcuate ridge between uncus lobes over apex of aedeagus weakly elevated and laterally incurved.

### Female

Operculum (fig. 104). – Pale ochraceous, reaching to just beyond posterior margin of abdominal segment 2 or to one third of segment 3. Lateral margin either weakly undulate or sinuate in the basal one third and weakly convex to the rectangular to obtuse laterodistal corner of the operculum. Posterior margin weakly undulate and strongly convex toward meracanthus.

Abdomen. – Dorsally brown, often covered with golden or more silvery pilosity, and sometimes with indistinct marking consisting of sublateral or lateral dark spots on segments 3-6, a pair of small dark, paramedian spots at anterior margins of segments 5-8, and a pair of paramedian triangular dark marks at anterior margin of segment 9. Ventrally with black-brown coloration along posterior margins of segments 4-6 and along lower margins of segment 9.

Measurements ( $n = 7 \text{ ♂ } 6 \text{ ♀}$ ). – Body length ♂ 34.5-43 mm, ♀ 30.5-37 mm; head width ♂ 11.1-12.4 mm, ♀ 11.2-13.4 mm; pronotum width ♂ 11.6-13.5 mm, ♀ 11.6-14.5 mm; tegmen length ♂ 44.5-52 mm, ♀ 47-53 mm.

### Variability

Two different forms can be distinguished by the coloration and marking of the tegmina. Specimens from Kalimantan, Sarawak, Brunei and eastern Sabah share a yellowish brown suffusion in the hyaline

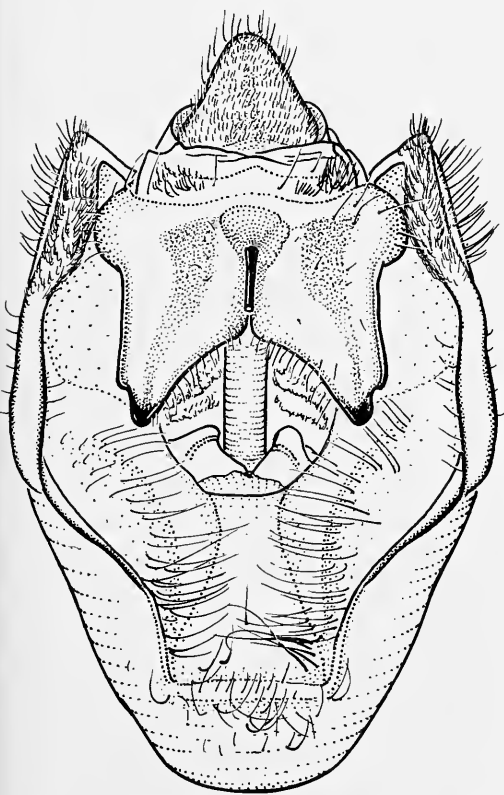
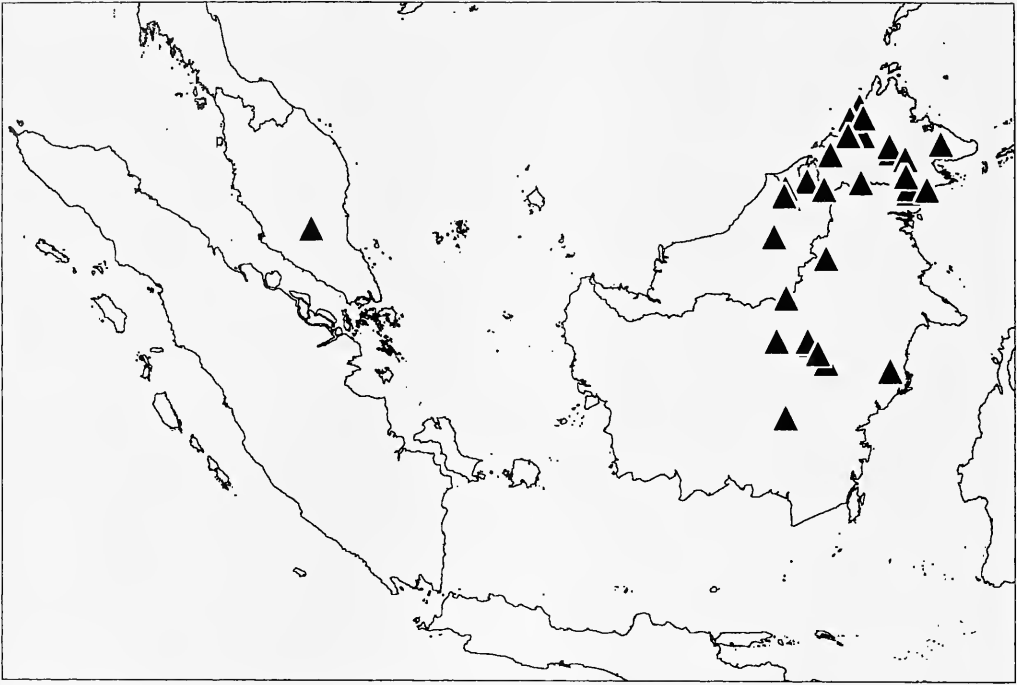


Fig. 113. *Orientopsaltria alicola*, male pygofer in ventral view, Sabah, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun.



Figs. 114. Distribution of *Orientopsaltria alticola*.

tegmina, conspicuous spots at the bases of the 2nd and 3rd apical areas, and smaller but distinct spots at the bases of the 5th and 7th apical areas and at the apices of the longitudinal veins. Specimens from southwest Sabah, collected in SE of Tenom, in the Long Pa Sia area 105 km south of Beaufort, and along the Keningau Nabawan road, have hyaline tegmina without yellowish brown suffusion, and much less distinct spots at the bases of the 5th and 7th apical areas and at the apices of the longitudinal veins. Wings are hyaline in both forms. Specimens with distinctly marked tegmina are usually larger than specimens with less distinctly marked tegmina.

Material examined. – 26♂ 129♀. MALAYSIA: PENINSULAR MALAYSIA: PAHANG: Pahang, Tasik Chini, Kg. Melayu, 14.v.1993, Zaidi, Ruslan, Kudin, 1♂ (UKM). – SABAH: 105 km S of Beaufort, Long Pa Sia area, confluence Sg Pa Sia - Matang, 4°24'N 115°43'E, 1000 m, 1.iv.1987, semicultivated area near disturbed evergr. tropical rainforest, at light, J. van Tol & J. Huisman, 3♀, same data but 10.iv.1987, 1♀, 13.iv.1987, 1♀ (RMNH); 105 km S of Beaufort, Long Pa Sia area, Payakalaba, 4°25'N 115°44'E, 1000 m, 12.iv.1987, somewhat disturbed kerangas vegetation, at light, 18.25-21.00, Van Tol & Huisman, 2♀ (RMNH); Long Pa Sia, airstrip along S. Pa Sia, 4°25'N 115°43'E, 1090m, 14.x.1986, J. Huisman et al., 1♀ (RMNH); L. Pa Sia, airstrip, 2-3.xii.1989, 1000 m, A.L. cultivated, JB8906-7, J. Huis-

man, 3♀ (RMNH); Lembah Danum, 17.iii.1994, John, 1♀ (UKM); Lembah Danum, 2.iv.1989, Salleh, Ismail & Nor, 2♀ (UKM); Lembah Danum, 3-5.xii.1991, Zaidi, Is, Lan, Yus, 1♀ (UKM); Danum Valley, 5°01'N 117°47'E, 120 m, 17.x.1987, lowland mixed dipterocarp forest, light trap sample primary forest edge, NMW Sabah (Borneo) Expedition, NMW.Z.1987.094, A.H. Kirk-Spriggs, 1♂ (NMW); Danum Valley, 5°01'N 117°47'E, 200 m, 19.xi.1987, light trap sample understorey forest, NMW Sabah (Borneo) Expedition, NMW.Z.1987.094, A.H. Kirk-Spriggs, 1♂ (NMW); Danum Valley, Danum Valley Fld Centre, 100-200 m, 18-29.x.1987, multistr. evergr. forest along river, at light, Krikken & Rombaut, 3♀ (RMNH); Danum Valley, 70 km W Lahad Datu, Field Centre, nr. Main Trail East, 150 m, 3.xii.1989, sample Sab. 55, primary forest margin along road, at light, M.J. & J.P. Duffels, 2♀ (ZMA); Danum Valley, 70 km W Lahad Datu, Sungai Segama, W side suspension bridge, 150 m, 29.xi.1989, sample Sab. 47, understorey secondary growth/canopy riverine rainforest, at light, M.J. & J.P. Duffels, 1♀ (ZMA); Danum Valley, 70 km W Lahad Datu, Field Centre at Sungai Segama above staff-quarters, 150 m, 5.xii.1989, sample Sab. 57, at light, M.J. & J.P. Duffels, 1♀ (ZMA); Danum Valley, 70 km W Lahad Datu, Field Centre, 29.xi-5.xii.1989, sample Sab. 48, at light, M.J. & J.P. Duffels, 1♀ (ZMA), same data but 10-17.xii.1989, sample Sab.63, 1♀ (ZMA); 60 km W Lahad Datu, DVFC, buildingsite staffquarters, 117°48' E 4° 58'N, 150 m, 28.x.1987, ML-light, J. Huisman & R. de Jong, 1♀ (RMNH); 75 km W Lahad Datu, confl. S. Sabran, S. Danum, S/N, 117°41'E 4°57'N, 200 m, 23.x.1987, J. Huisman & R.

de Jong, 1♂ 1♀ (RMNH), same data but 24.x.1987, 1♀, same data but 25.x.1987, 2♀ (RMNH); 65 km W of Lahad Datu, Danum Valley Field Centre at junction Sg Segama and Sg Palum, S. Purut camp, 117°45' E 4° 57' N, 200 m, 26.x.1987, ML-light, J. Huisman & R. de Jong, 1♀ (RMNH); Inanam, Klansom, 22.ix.1991, Zaidi, 3♂ 4♀ (UKM); R. Karamvak, Kunantong, 200', 3.ix.1977, M.E. Bacchus, B.M. 1978-48, 1♀ (BMNH); 12 km NNE Ranau, Poring Hot Spring, staffquarters, 116°42'E 6°03'N, xi.1987, 550 m, J. Huisman & R. de Jong, 1♀ (RMNH); Mount Kinabalu, x.1979, Michel Duranton, 1♂ (MNP); K. Kinabalu, Bukit Padang, 50 m, 2.x.1989, 1♀, same locality and altitude but 27.ix.1989, Safran, 1♀ (UKM), 24.vii.1989, Azman, 1♂ (UKM); Kota Kinabalu, B. Padang, 20.vii.1990, H. K. Chan, R. A. J., 1♀ (UKM); K. Kinabalu, UMS (KYS), 15 m, i.1996, Nordin Wahid, 1♂ (UMS); Jesselton, 22.xii.1967, P.J.L. Roche, Brit. Mus. 1990-24, 1♂, same data but: 10.ii.1968, 1♂, 1.i.1968, 2♀, 2.xii.1967, 1♀ (BMNH); Kinabatangan, Batu Putih, 6-15.iv.1994, Nordin Wahid, 1♂ 6♀ (UKM); 39 km road Keningau - Nabawan, Sg Sook, 116°E 5°N, 350 m, 17.xi.1987, J. Huisman & R. de Jong, 2♀ (RMNH); Limbang, Mendamit, 18-23.ii.1991, Zaidi, 3♀ (UKM); Menggatal, UKMS, 20.ix.1990, H. K. Chan, R.A.J., 2♂ (UKM); Menggatal, 13.ix.1992, Lae Kwong Aik, 1♂ (UKM); Taman Negara, Poring, 6-10.xii.1990, Zaidi, Ismail, Ruslan, 1♀ (UKM); Poring nr Kg Perancangan: confl Sg Langanau x Sg Makadan, 250 m, ML, 116°48'E 6°04'N, 27.xi.1986, J. Huisman, 1♀ (RMNH); Poring, 9 mi. N. of Ranau, 1600', 26-29.iv.1970, T.W. & M.C. Davies, 1♂ (CAS); Sandakan Dist., Rumidi, R. Labuk, 16-30.ix.1973, C. Pruett, B.M. 1975-590, 2♀ (BMNH); 60 km W of Lahad Datu, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun, 150 m, 4°58'N 117°48'E, at light, 17-18.iii.1987, 18.30-21.00, edge of untouched evergr. lowl. rainforest, leg. Van Tol & Huisman, 1♂ 4♀ (RMNH); 60 km W of Lahad Datu, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun, 150 m, 4°58'N 117°48'E, at light, brooklet above Lotus pond, 25.iii.1987, 18.30-21.00, untouched evergr. lowl. rainforest, leg. Van Tol & Huisman, 1♀, same locality but: bridge of Segama, 150 m, 20.iii.1987, at light, 18.20-21.00, clearing, edge of untouched evergr. lowl. rainforest, leg. Van Tol & Huisman, 1♂ (ZMA) 3♀ (RMNH); 15 km NW Kg. Sapulut, Kg. Labang, Sg. Saburan, 116°36'E 4°42'N, 300m, 1.v.1987, ML-light, J. Huisman, 1♀ (RMNH); Sinoa, 1800', 18.viii.1977, M.E. Bacchus, B.M. 1978-48, 1♀ (BMNH); Tawau, Brumas Camp, xi.1974, C. Pruett, B.M. 1975-590, 7♀ (BMNH); Tawau, Cocoa Res. Station, 1962, Y Hirashima, Light Trap, 3♀ (BPBM); Tawau, Taman Bukit Tawau, 1-13.v.1992, Ruslan, 4♂ 5♀ (UKM); Tawau, Quoin Hill, Cocoa Res. Station, 16-19.viii.1962, Y. Hirashima, 1♀, same data but 1.viii.1962, Light Trap, 2♀, 6.xi.1962, Malaise Trap, 1♀, 10.ix.1962, 3♀, 13.ix.1962, 1♀ (BPBM); Tawai Plateau, 1300', 8.ix.1977, M.E. Bacchus, B.M. 1978-48, 1♀ (BMNH); 16 km NE Tenom, Agr. Res. Station, resthouse, 115°59'E 5°12'N, 270 m, 22.xi.1987, J. Huisman & R. de Jong, 1♀ (RMNH); 16 km NE of Tenom, orchid garden, surr. by plantations, 180 m, vi.1986, J. Huisman, 1♀ (RMNH). — SARAWAK: Bintulu, Pekan, 3.iii.1992, Zaidi, 1♀ (UKM); Gunung Mulu Nat. Park, Site 17, Nr. Long Melinau, 313441, low secondary forest, MV on river bank, 50 m, May, J.D. Holloway, RGS Mulu exped., B.M. 1978-206, 2♀, same data but: Site 16, Long Pala (Base), 324450, 70 m, Allu./second. forest, MV-on batu-Canopy, March, 1♂ 2♀,

Site 7, Long Pala (Base), 324450, 50 m, Alluvial/secondary forest, Acl-understorey, 2♀, site 28, Nr. Long Pala, FEG 1a, 328428, 50 m, alluvial forest, MV-understorey, 1♀ (BMNH); Foot of Mt. Dulit, junction of rivers Tinjar and Lejok, 24.viii.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 3♀, same data but: 30.viii.1932, 1♀, 7.ix.1932, 1♀, 1.x.1932, 2♀, 5.x.1932, 1♀ (BMNH); Mt. Dulit, 4000 ft, moss forest, 6.x.1932, Oxford Univ. Exp., B.M. Hobby & A.W. Moore, B.M. 1933-254, 1♂, same data but: 2.ix.1932, 1♀ (BMNH). — BRUNEI: Belabau, c. 20 m, 28.iii.1990, at light, M.J.E. Coode, 1♀, same data but 29.iii.1990, 1♀ (ZMA); Belait, Sg. Pasir, 4°09'N 114°43'E, 50 m, mixed Dipt-peatf., 19.15-20.15, leg. E.F. de Vogel, 05.xi.1989, 1♀ (RMNH); Belait distr., Manilas, 65 km SW Brunei Town, 20-21.iii.1968, wet primary forest, D.E. Hardy collector, 1♀ (BPBM). — INDONESIA: KALIMANTAN: Long Nawang, leg. Mjöberg, 1925, 1♀ (ZMA); 8-30 km SE of Longiram, S. Mahakam, 17-18.iv.1996, R. Sözer, 1♀ (ZMA); Camp Jangau, 15 km S of Longboh, S. Mahakam, 15.xii.1995, R. Sözer, 1♀ (ZMA); Dajah Bilang, 40 km NW of Longiram, S. Mahakam, 15.i.1996, R. Sözer, 1♀ (ZMA); Long Bagun, 25 km SE of Longboh, S. Mahakam, 7.iv.1996, R. Sözer, 1♀ (ZMA); Kayan-Mentarang Nature Reserve, Lalut Birai, IIS 940507, WWF station, 28.3-16.iv.1994, lowland diptero forest, 378 m, 2°52'N 115°49'E, UV light, B. Hubley & D. C. Darling, 3♀ (ROME); Long Bloo-oe, 1.1899, Borneo Exped., Dr. Nieuwenhuis, 1♀ (RMNH); Boentok, Barito Riv., G. C. Shortridge, 1910-123, 5♀ (BMNH); Samarinda, 24.v.1909, C.A. Lorentz, 1♂ (ZMA).

### *Orientopsaltria inermis* (Stål, 1870)

(figs. 115-118, 123, 125, plate 5: 4)

*Cosmopsaltria inermis* Stål, 1870: 708. Lectotype ♂ (here designated; the red 'Typus' label is an unauthorized curatorial label): 'Ins. Philipp' (print), 'Semper' (print), 'inermis Stål' (handwritten), '327 63' (rose label; print and handwritten) 'Typus' (red label; print) (NHRs) [examined].

*Cosmopsaltria inermis*; Distant 1890: 49-50, pl. 6, figs. 15, a, b; Distant 1892b: xii; Distant 1906: 56; Kirkaldy 1907: 306; Moulton 1911a: 140; Distant 1912: 44; Oshanin 1912: 94; Matsumura 1918: 197, 210, 211; Kato 1925a: 18; Kato 1925b: 69; Kato 1927: 27; Kato 1928: 188; Kato 1931: 44, 58; Kato 1932: 165, 197; Metcalf 1963: 549-550; Nast 1972: 141; Endo & Hayashi 1979: 37, 38 figs. 9, 11; Duffels & Van der Laan 1985: 135.

*Orientopsaltria inermis*; Duffels 1983: 9; Duffels & Zaidi 1998: 321.

*O. inermis* is an endemic of Mindanao (fig. 123). Records of this species from Japan and Borneo are incorrect, and at least partly based on misidentifications. In Distant's publication of 1906, *O. inermis* was recorded from Yokahama, Japan, for the first time. Several later authors followed Distant and mentioned Japan as part of the distributional region of *O. inermis* (Metcalf 1963). More recent overviews of the cicadas of Japan (Kato 1956, 1961) do not list *inermis* as a Japanese species. *O. inermis* was also recorded from Borneo (Moulton 1911a), but in a later publi-

cation Moulton (1923) stated that this was a misidentification of *Orientopsaltria alticola*.

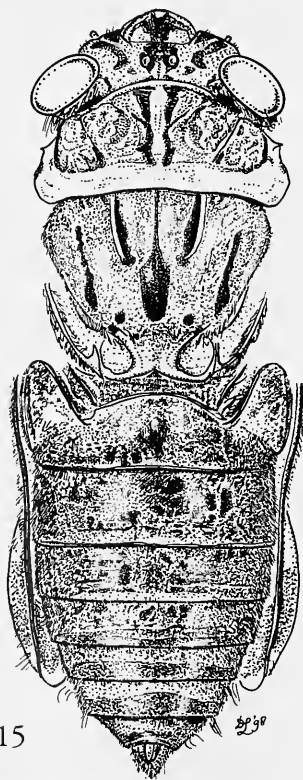
*O. inermis* and *O. confluens* can easily be separated from the other Philippine *Orientopsaltria* species by the median mesonotal fascia that strongly widens at two fifths of its length to at least  $6\times$  its anterior width (figs. 115, 119) and the rounded lateral pygofer lobes without protrusion (figs. 118, 122).

### Description

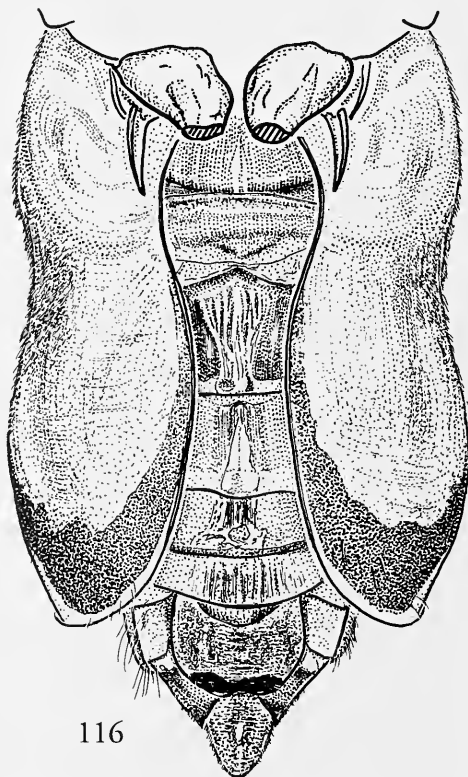
Ground colour brownish, sometimes with greenish tinge. Marking on head and thorax mostly black to black-brown. Apical part of underside of abdomen covered with white wax.

Head. – Dorsally with two black to black-brown, median marks: a trefoiled, mark enclosing the ocelli, and a low, sometimes bilobate, mark in front of anterior pronotum margin; both marks are rarely connected by two central brown to black lines; the trefoiled mark extends distad toward frontoclypeal suture, and continues in most specimens on the post-

clypeus in a brown to dark brown, anchor-shaped or distally widened mark touching median ground coloured oval spot or fused with the upper transverse lines on anterior part of postclypeus. Anterior part of supra-antennal plates often black to dark brown. A pair of oblique, dark to light brown, broad and straight fasciae extend from vertex lobes to the level of the paired ocelli; fasciae are about equally wide along their length, and as wide as or at least half as wide as distance between fascia and eye. A pair of very small spots latero-proximad of the paired ocelli are in a direct line with the oblique fasciae. A pair of small black triangles is situated medially of eyes against anterior margin of pronotum. Underside of vertex lobes either with dark brown fascia running from antenna to eye, or with (much) shorter fascia. Anterior part of postclypeus with 5-6 transverse brown to black-brown lines on either side; upper three lines reaching supra-antennal plates, other lines shorter; medial ends of transverse lines connected and enclosing an oval spot of the ground colour, though the lower side is often



115



116

Figs. 115, 116. *Orientopsaltria inermis*, male lectotype, Philippines, Semper. – 115, body in dorsal view; 116, abdomen with opercula in ventral view.

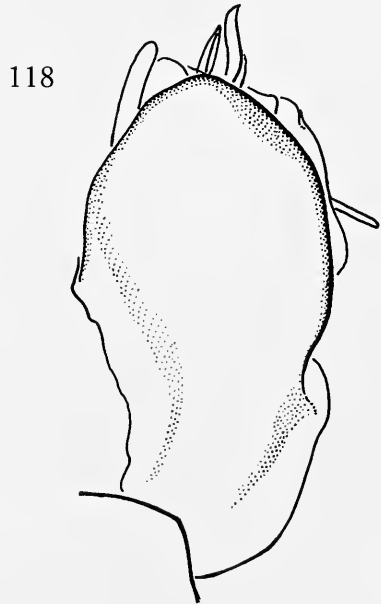
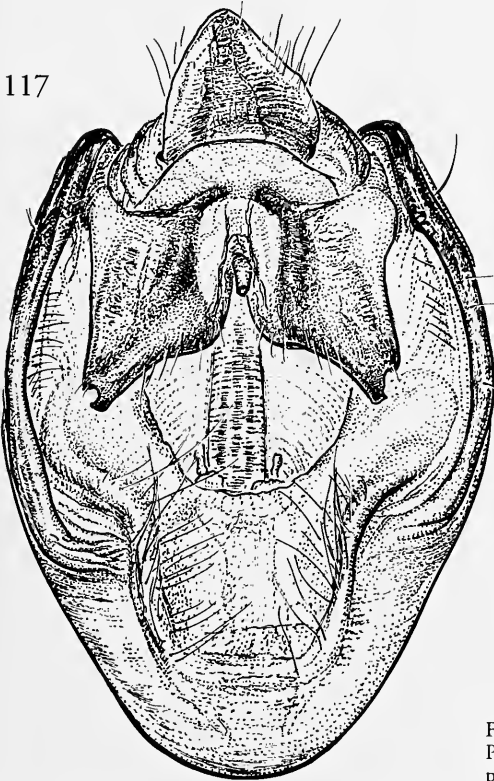
open. Remaining part of postclypeus unmarked. Anteclypeus often with lateral parts of apex brownish. Rostrum black-brown apically, and reaching just beyond hind coxae.

Thorax. — Pronotum. Paired central black fasciae slightly diverging from pronotal collar to anterior margin of pronotum; fasciae are narrowest at one third of length of pronotal disk and gradually widen distad to their triangular anterior ends, posterior ends crescentic or slightly widened. Anterior and posterior oblique fissures and lateral part of ambient fissure often brown to black-brown. A dark mark, just behind the eye, against anterior part of ambient fissure continues in several specimens in a narrow brown fascia running to a dark brown triangle at half-length of lateral margin of pronotal collar. A pair of distinct, dark brown spots between the two pairs of fissures is present in most specimens. Posterior margin of pronotal collar with very narrow, black line.

Mesonotum. — Five narrow to fairly narrow, black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation; the very narrow to extremely thin anterior half of the fascia

widens from about half-length, attains at least 6 but often many times its anterior width at two-fifths of length from base, and slightly narrows again toward cruciform elevation. Paramedian fasciae equally narrow and slightly converging from anterior margin to about half-length of mesonotum; posterior ends slightly recurved. A pair of small round black spots in front of cruciform elevation, and a pair of black marks just distally of these round spots at the ends of anterior branches of cruciform elevation. Lateral fasciae reaching from one fourth of mesonotum length to nearly posterior margin of mesonotum. Distance between paramedian and lateral fasciae 4-8× as wide as lateral fasciae. A pair of small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae.

Legs. — Fore femora with brown to black line connecting the spines along lower edge. Fore tibiae black-brown with exception of upperside; middle tibiae with distal one fourth to one third black-brown; hind tibiae proximally and on distal half black-brown to brown. Tarsi of fore and middle legs dark brown to black.



Figs. 117, 118. *Orientopsaltria inermis*, male lectotype, Philippines, Semper. — 117, pygofer in ventral view; 118, pygofer in lateral view.

Tegmina and wings. – Hyaline with yellowish brown suffusion. Tegmina with basal veins of 2nd and 3rd apical areas infuscated, and those of 5th and 7th apical areas less to weakly infuscated; apices of longitudinal veins hardly infuscated. Venation light to dark brown.

### Male

Operculum (figs. 116, 125). – Elongate and fairly broad, reaching to half-length abdominal segment 6 or to anterior margin of segment 7. Medial margin evenly convex. Lateral margin convex in basal third, distinctly concave at one third or one fourth of its length from base, and fairly strongly convex to the broadly rounded apex. Rim along operculum margin dark brown to black, with exception of basal part of medial margin and apical margin. Brown to black-brown coloration along medial margin widening from one fourth of length from base to black-brown coloured apical one third or one fourth of operculum, but apical marginal part covered with white wax.

Abdomen. – Light brown, very occasionally with a greenish tinge. Dorsal marking dark brown; timbal coverings either unmarked, or with laterobasal corner or lateral half of timbal covering dark brown; segment 2 with a pair of small, transverse, paramedian spots at half the segments height, segments 3 and 4 with a pair of larger paramedian spots, which are 1.5–2× as wide as long, and reach the anterior segment margins only in the holotype; segments 5 and 6 dark-coloured sometimes with indistinct transverse marking; segments 7 and 8 dark-coloured. Ventral side of abdomen proximally light brown and turning to dark brown from segment 5 to the posterior.

Genitalia (figs. 117–118). – Lateral pygofer lobes apically rounded without protrusion. Basal pygofer lobes with low parallel ridges. Basal part of uncus slightly globose. Uncus with small, weakly globose, basal part. Uncus lobes adjacent medially, with oblique, weakly undulate apical margins, ending laterally in a weakly developed apical spine, while the almost straight or weakly concave lateral margins have a small blunt spine just above the apical spine. Narrow arcuate ridge between uncus lobes over apex of aedeagus weakly elevated and laterally incurved.

### Female

Operculum. – Pale ochraceous, reaching to just beyond posterior margin of abdominal segment 2 or to one third of segment 3. Lateral margin weakly undulate; laterodistal corner of operculum rounded rectangular. Posterior margin weakly undulate and strongly convex close to meracanthus.

Abdomen. – Dorsally brown; segments 2–4 often with sublateral patches of white wax; segments 2–5 with a pair of faint to distinct, paramedian, dark-

brown marks at half the segment length; segments 6–8 brown to dark brown, posterior halves of these segments sometimes darker than anterior parts; segment 9 with a pair of paramedian, triangular, dark brown marks. Ventrally brown with a pair of dark brown lateral spots on sternite 7.

Measurements (n = 6♂ 6♀). – Body length ♂ 29–35.5 mm, ♀ 29–32 mm; head width ♂ 9.3–10.7 mm, ♀ 9.9–11.2 mm; pronotum width ♂ 9.5–11.2 mm, ♀ 10.3–11.5 mm; tegmen length ♂ 36.5–48 mm, ♀ 41–48 mm.

Material examined. – 11♂ 25♀. PHILIPPINES: Ins. Philipp, Semper, *inermis* Stål, Paratype, 1♂ paralectotype of *Cosmopsaltria inermis* (NHRs), same labels but with Allotypus label, 1♀ paralectotype of *Cosmopsaltria inermis* (NHRs). – MINDANAO: Davao Oriental, Boston, Mt Aglutanon, Camp 55, 1020 m, 29.v–7.vi.1996, Müller, Buenafe, Gorostiza leg., coll. Roland A. Müller, 4♂ (RMNH); Agusan, S. Francisco 10 km SE, 13.xi.1959, L. Quate & C. Yoshimoto, 1♀ (BPBM); Bukidnon, Mt. Katanglad, 1250 m, 4–9.xii.1959, L.W. Quate, 1♀ (BPBM); Zamboanga del Sur, Lemesahan, 600 m, 8.ix.1958, H.E. Milliron, 3♂ (BPBM) 1♂ (ZMA); Misamis Or., Mt. Kibungol, 20 km SE of Gingoog, 700–800 m, 9–18.iv.1960, H. Torrevillas, 1♂ 10♀ (BPBM) 1♂ (ZMA); Misamis Or., Minubanan, 3500–4000 m, 5–9.iv.1961, H.M. Torrevillas, 1♂, same data but: 1050–1200 m, 5♀ (BPBM); Misamis Or., Mt. Empagatao, 1050–1200 m, 19–30.iv.1961, H.M. Torrevillas, 1♂ 3♀ (BPBM); Misamis Or., Minalwang, 1050 m, 24.iii–4.iv.1961, H. Torrevillas, 2♂ 4♀ (BPBM); Mt. Apo, Sibulan Riv., 2000 ft, 8.x, C. F. Clagg, 1♂, same data but: 7.xi, 1♂ (MCZ), 11.x., 1♂, (ZMA); Surigao, 1♂ (BMNH); Zamboanga del Norte, 25 km S. Manucan, 500 m, 18.x.1959, L.W. Quate, 1♂ 1♀, same data but 400 m, 1♀ (BPBM); Surigao del Sur, Carmen 2. Equipment Shop, km 11 Lanang Line, 600–650 m, 21–24.iv.1995, lighttrap, Müller, Buenafe, Gorostiza leg., coll. Roland A. Müller, 1♂ (RMNH).

### *Orientopsaltria confluens* sp. n. (figs. 119–123, 126, plate 6 fig. 1)

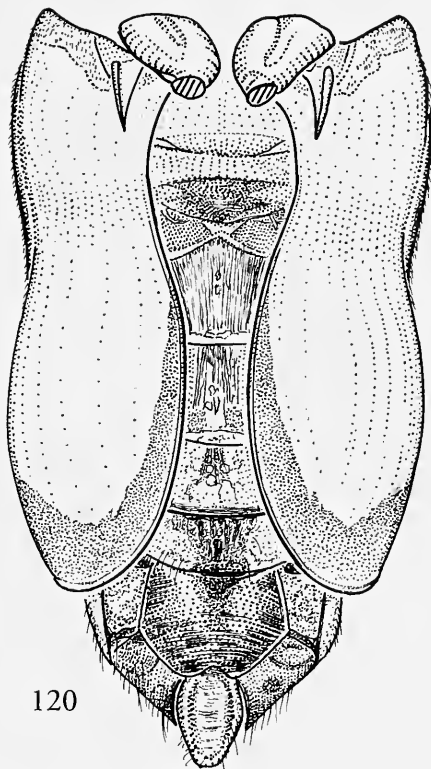
Type material. – Holotype ♂: 'Philippinen / Basilan II–III.98 / Doherty / ex. coll. H. Fruhstorfer' (HNHM). – Paratype: PHILIPPINES: BASILAN I.: Philippin, Basilan, 1♂ (BMNH).

This species is only known from the small island of Basilan, the most northern island in the Sulu Archipelago between Borneo and Mindanao (fig. 123). Basilan Island is separated from the western Zamboanga Peninsula of Mindanao by a narrow strait.

*O. confluens* is very closely allied to *O. inermis*. *O. confluens* has the genitalic features of *inermis*, but it is smaller than *inermis*, it has only two spots (and hardly recognizable marginal spots) on the tegmina, and more or less fused median and paramedian fasciae on the mesonotum (fig. 119).



119



120

Figs. 119, 120. *Orientopsaltria confluens*, male holotype, Philippines, Basilan. – 119, body in dorsal view; 120, abdomen with opercula in ventral view.

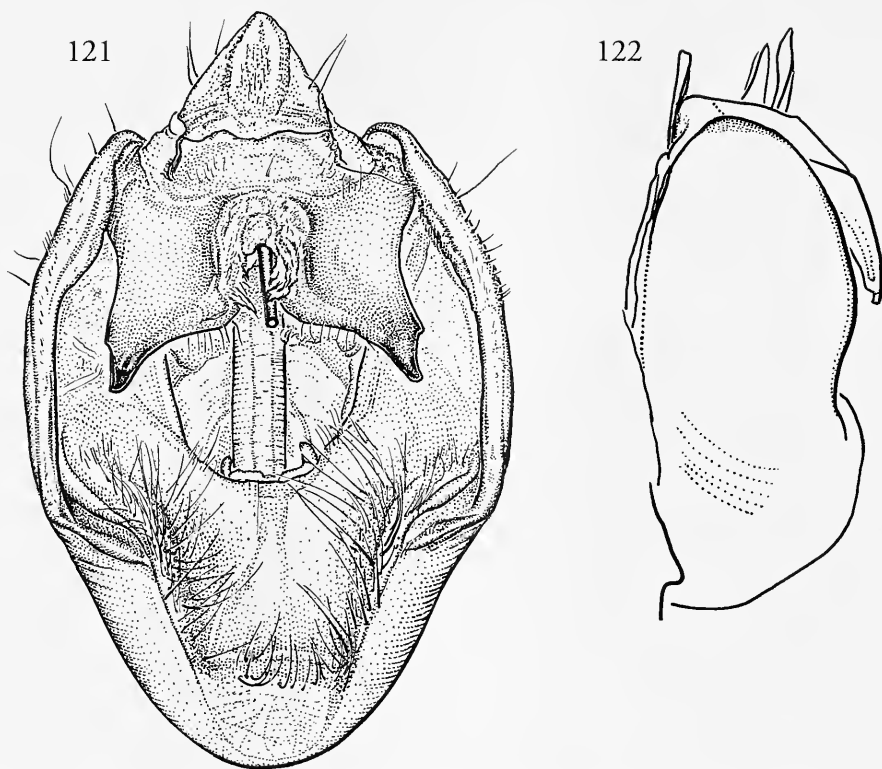
### Description of male

Ground colour brownish. Marking on head and thorax brown to black-brown.

Head. – Ocelli enclosed by black-brown mark, which is connected with anterior pronotum margin by two central, proximally widened, brown lines; the trefoiled mark touches the frontoclypeal suture, and continues on the postclypeus in a faint, brownish, mushroom-shaped mark touching median ground coloured oval spot on anterior part of postclypeus. Supra-antennal plates with brown mark(s). A pair of oblique, dark brown, irregular fasciae, 1-2× as wide as distance between fascia and eye, extend from vertex lobes to the level of the paired ocelli. A pair of small spots latero-proximad of paired ocelli are in a direct line with the oblique fasciae. A pair of small black triangles is situated mediad of eyes against anterior margin of pronotum. Underside of vertex lobes with narrow light brown fascia running from antenna to two-thirds of distance between antenna and eye. An-

terior part of postclypeus with 6 transverse, brown, lines on either side; 2-3 lines reaching supra-antennal plates, other lines shorter; medial ends of transverse lines connected and enclosing an oval spot of the ground colour, of which the lower side is often open. Remaining part of postclypeus unmarked. Anteclypeus unmarked. Rostrum dark brown apically, and reaching just beyond hind coxae.

Thorax. – Pronotum. Paired central black fasciae narrow, slightly diverging from pronotal collar to anterior margin of pronotum, distal ends triangularly widened, proximal ends only slightly widened. Anterior oblique fissures dark brown at their distal ends, and with a very narrow, brown line just above the proximal one third. A relatively broad, dark brown mark extending from eye along anterolateral part of ambient fissure continues as a narrow brown fascia on the pronotal collar and ends in a black-brown spot at the collar margin. This spot is one end of a narrow, black line along the posterior margin of the pronotal



Figs. 121, 122. *Orientopsaltria confluens*, male holotype, Philippines, Basilan. – 121, pygofer in ventral view; 122, pygofer in lateral view.

collar. A pair of vague spots is sometimes situated between the two pair of fissures.

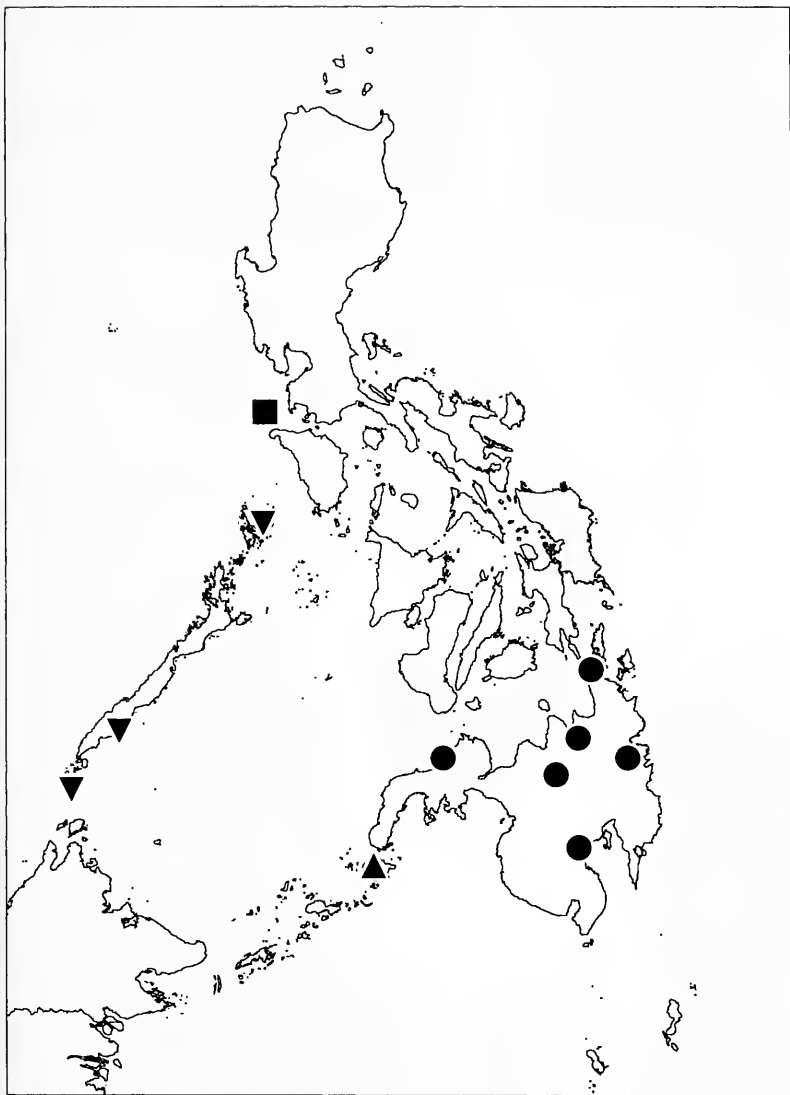
**Mesonotum.** – Five black fasciae. Median fascia anteriorly fairly narrow, reaching from anterior margin of mesonotum to cruciform elevation, gradually widening from about half-length to 8 or many times its anterior width at two fifths of its length from base, and slightly narrowing again toward cruciform elevation. Paramedian fasciae, 2-3 $\times$  as wide as anterior part of median fasciae, slightly converging from anterior margin to about half-length of mesonotum; posterior ends recurved and either just connected (holotype) or very broadly connected with median fascia. A pair of small round black spots in front of cruciform elevation, and a pair of black marks distally of these round spots at ends of anterior branches of cruciform elevation. Lateral fasciae consisting of a dark mark at anterior mesonotum margin and a linear part reaching from three fourths to two thirds of mesonotum length to nearly posterior margin of mesonotum. Distance between paramedian and lateral fasciae 2-3 $\times$  as wide as broadest posterior part of lateral fasciae. A

pair of small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae.

**Legs.** – Fore femora with brown to black line connecting the spines along lower edge. Fore tibiae black-brown with exception of upperside; middle and hind tibiae with distal one sixth dark brown; hind tibiae proximally and on distal half black-brown to brown. Tarsi of fore and middle legs dark brown to black.

**Tegmina and wings.** – Hyaline with yellowish brown suffusion. Tegmina with basal veins of 2nd and 3rd apical areas infuscated; apices of longitudinal veins hardly infuscated. Venation light to dark brown.

**Operculum** (figs. 120, 126). – Elongate and fairly broad (paratype) to broad (holotype), reaching just beyond posterior margin of abdominal segment 6. Medial margin evenly convex. Lateral margin convex in basal third, distinctly concave at one third or one fourth of its length from base, and fairly strongly convex to broadly rounded apical margin of operculum. Rim along operculum margin dark brown, with exception of the apical margin, and the basal half of the



Figs. 123. Distribution of *Orientopsaltria inermis* (rounds), *O. confluens* (triangle), *O. latispina* (squares), and *O. noonadani* (reversed triangle).

lateral margin (holotype). Brown coloration along medial margin widening from one third to one fourth of length from base to black-brown coloured apical one third or one fourth of operculum, but the apical marginal part covered with white wax.

Abdomen. – Light brown. Dorsal marking as in *O. inermis*; lateral half of timbal covering dark brown.

Genitalia (figs. 121-122). – As in *O. inermis*.

Measurements ( $n = 2\delta$ ). – Body length 29.5-31.5 mm; head width 9.2-9.7 mm; pronotum width 9.4-9.9 mm; tegmen length 37.5 mm.

***Orientopsaltria fuliginosa* (Walker, 1850) comb. n.**  
(figs. 105, 127, 129-135, plate 6 fig. 2)

*Dundubia fuliginosa* Walker, 1850: 60-61 '21. Holotype  $\delta$ : *Dundubia fuliginosa mas*' (printed), 'Phil Islds, 53 77' (handwritten; round blue label), 'Type' (print within green circle; round label) (BMNH) [examined].

*Dundubia fuliginosa*; Dohrn 1859: 72; Stål 1862c: 480; Walker 1868: 84-87 (partim: Philippines); Duffels 1977: 124

*Cosmopsaltria fuliginosa*; Stål 1870: 708-709; Distant 1890: 50, pl. 6 figs. 16, 16a-b; Distant 1892b: xii; Breddin 1901: 25 (partim: Philippines); Endo & Hayashi 1979: 38 fig. 13; Duffels & Van der Laan 1985: 135.

*Cosmopsaltria* sp. aff. *fuliginosa* Endo & Hayashi, 1979: 38.

*Platylomia fuliginosa*; Distant 1906: 61-62; Kirkaldy 1907: 306; Distant 1912: 49; Kato 1932: 166; Metcalf 1963: 618-619.

*Dundubia melpomene* Walker, 1850: 76-77. Holotype ♀: '38. Dundubia melpomene' (printed), 'Phil Isl, 42 22' (print), 'Type' (print within green circle; round label) (BMNH) [examined].

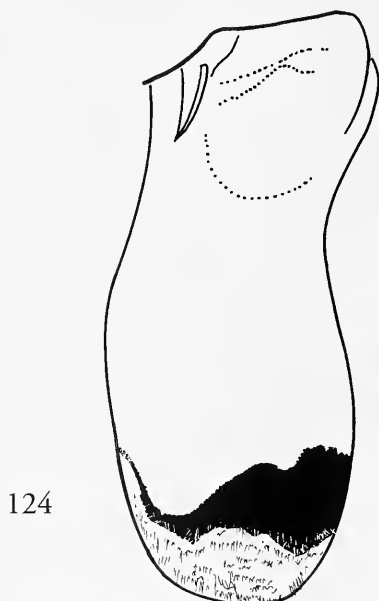
*Dundubia melpomene*; Dohrn 1859: 73; Stål 1862c: 480 (in syn. of *D. fuliginosa*); Stål 1870: 708 (in syn. of *D. fuliginosa*); Distant 1890: 50 (in syn. of *D. fuliginosa*); Distant

1906: 62 (in syn. of *D. fuliginosa*); Distant 1912: 49 (in syn. of *D. fuliginosa*); Metcalf 1963: 618-619 (in syn. of *D. fuliginosa*).

[Misidentifications:

*Dundubia fuliginosa*; Walker 1868: 84-87 (partim: Celebes, Tondano = *Dilobopyga chlorogaster* (Boisduval)); Breddin 1901: 25 (partim: Tondana = *Dilobopyga chlorogaster* (Boisduval)).

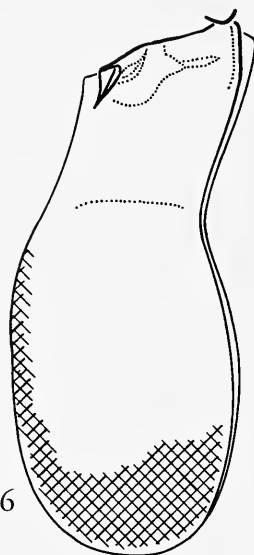
*Cosmopsaltria fuliginosa*; Breddin 1901: 25 (partim: Tondana = *Dilobopyga chlorogaster* (Boisduval)).



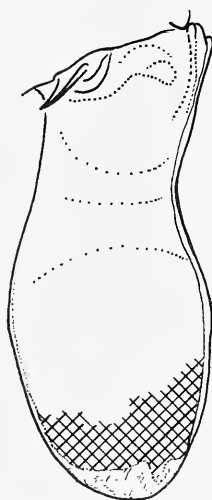
124



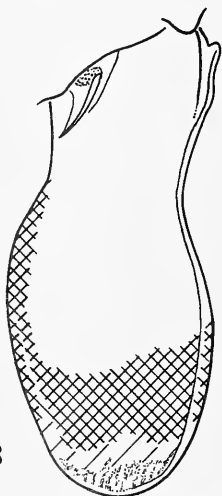
125



126



127



128

Figs. 124-128. Male opercula of *Orientopsaltria* species in lateroventral view. - 124, *O. alticola*, Sabah, Danum Valley Field Centre at junction Sg Segama and Sg Palum Tambun; 125, *O. inermis*, lectotype, Philippines, Semper; 126, *O. confluens*, holotype, Philippines, Basilan; 127, *O. fuliginosa*, Philippines, Luzon, Orion, Bataan; 128, *O. latispina*, holotype, Philippines, Lubang.

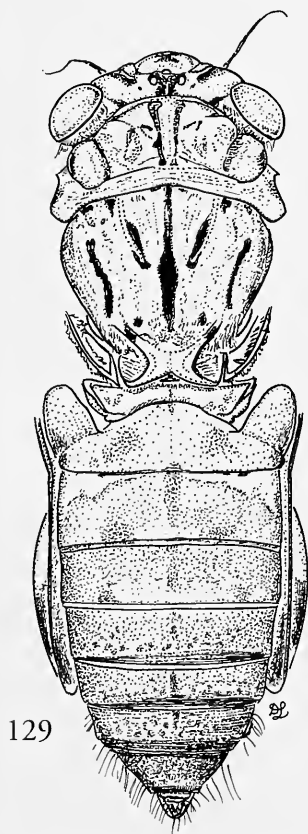
*O. fuliginosa* is a very variable species (see variability following this description) with a wide distribution from Luzon in the north to Mindanao in the south (fig. 135). *O. fuliginosa*, its nearest relative *O. latispina*, and *O. confluens* can be distinguished from the other Philippine *Orientopsaltria* species by the marking on the tegmina consisting of spots at the bases of the 2nd and 3rd apical areas. The other two Philippine species have spots at the bases of the 2nd, 3rd, 5th and 7th apical areas, and at the apices of the longitudinal veins. The differences between *O. fuliginosa* and *O. latispina* are described under the latter species. *O. fuliginosa* can easily be separated from *O. confluens* by the median mesonotal fascia of the latter which is strongly widened at two fifths of its length to at least  $6\times$  its anterior width.

### Description

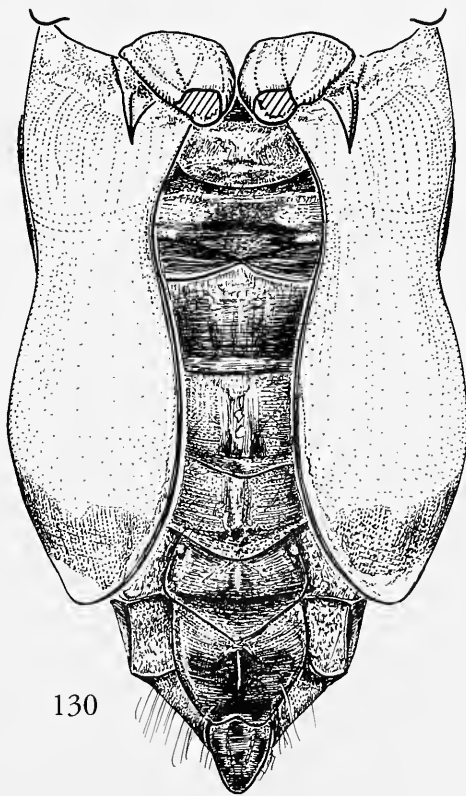
Ground colour brownish, sometimes with greenish tinge. Marking on head and thorax mostly black to

black-brown. Underside of head and thorax, especially the lateral parts, and underside of abdomen often covered with white wax.

Head. — Dorsally with median, trefoil shaped black to black-brown mark, which is either occasionally (Luzon, Los Negros) or more often (Mindanao) connected with anterior pronotum margin, and broadly connected with the frontoclypeal suture. Anterior margin of supra-antennal plates black to dark brown. A pair of oblique light to dark brown broad fasciae extend from vertex lobes to the level of the paired ocelli; fasciae are about equally wide along their length. A pair of very small spots latero-proximad of the paired ocelli are in a direct line with the oblique fasciae. Another pair of small black spots is situated mediad of eyes against anterior margin of pronotum. Underside of vertex lobes either with very narrow to broad, light brown to black-brown fascia running from antenna to eye. Postclypeus with mediodorsal, transverse, curved line touching proximal part of an oval line en-



129



130

Figs. 129, 130. *Orientopsaltria fuliginosa*, male. — 129, body in dorsal view, Philippines, Negros, Dumaguete; 130, abdomen with opercula in ventral view, Philippines, Luzon, Orion, Bataan.

closing a median spot of ground colour; in some dark-coloured specimens from Mindanao the transverse curved line is broadly connected with the frontoclypeal suture by a median black fascia. Anterior part of postclypeus with 5-6 transverse, brown to black-brown, lines on either side; upper 4 lines reaching supra-antennal plates, other lines shorter; medial ends of the 5-6 transverse lines connected by a line enclosing the oval spot mentioned above. Lower part of postclypeus either with a small to fairly large, medial, brown spot or line at clypeal suture, or with a pair of central lines connected at clypeal suture, or occasionally unmarked. Anteclypeus with lateral parts of apical half brownish, but sometimes unmarked. Rostrum black-brown apically, and reaching just beyond hind coxae.

**Thorax.** – Pronotum. Paired central black fasciae slightly diverging from pronotal collar to anterior margin of pronotum, fairly narrow, narrowest or interrupted at one third of length, and widened to their anterior and posterior ends. Area between central fasciae fairly narrow. A fairly large brown mark, just behind the eye, at anterior part of ambient fissure continues in several specimens in a narrow brown to black-brown fascia in the lateral part of the ambient fissure and the posterior oblique fissure. Anterior oblique fissures brown to black-brown in some specimens only. An often light brown mark is found at half-length of lateral margin of pronotal collar. A pair of brown spots between the two pair of fissures is found in some specimens only. Posterior margin of pronotal collar with very narrow, black line.

**Mesonotum.** – Five black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation, except in the specimens from Luzon, which often have a shorter fascia reaching to three fourths of mesonotum length only; the fascia is often equally narrow along its whole length, but the narrow anterior part of the fascia sometimes widens at three fifths of its length to 2-4× its anterior width, and slightly narrows again toward cruciform elevation. Paramedian fasciae slightly converge from anterior margin to about half-length of mesonotum; posterior ends slightly recurved; anterior one third to one fourth of fasciae often missing or very narrow. A pair of small round black spots in front of cruciform elevation, and a pair of very small, black-brown marks just distally of these round spots at the ends of anterior branches of cruciform elevation. Lateral fasciae usually narrow to fairly narrow, reaching from one fourth of mesonotum length to nearly posterior margin of mesonotum, but in the specimens from Luzon the fasciae are sometimes very narrow and much shorter, and occasionally even lacking. Distance between paramedian and lateral fasciae 3-8×, and occasionally, many times as

wide as lateral fasciae. A pair of small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae.

**Legs.** – Fore femora with subapical light brown to black-brown line connecting the spines along lower edge. Fore tibiae with underside and apical part brownish; middle tibiae with distal one third to one sixth brown, and dark-coloured specimens with a brown spot at proximal end of upperside. Tarsi of fore and middle legs dark.

**Tegmina and wings.** – Hyaline with yellowish brown suffusion. Tegmina with basal veins of 2nd and 3rd apical areas infuscated. Venation light to dark brown.

### Male

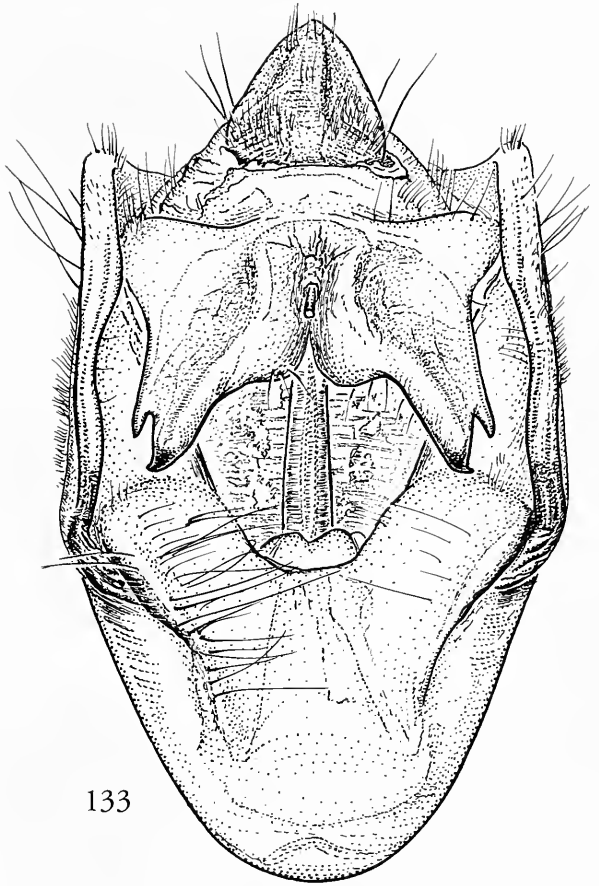
**Operculum** (figs. 127, 130). – Fairly elongate and broad, reaching to half-length abdominal segment 6 or to half-length segment 7. Medial margin evenly convex. Lateral margin convex in basal third, distinctly concave at one third or one fourth of its length from base, and strongly convex to broadly rounded apex. Rim along operculum margin brown, with exception of basal two fifths of medial margin and the apical margin. Brownish coloration along medial margin widening from one third of length or half-length of medial margin to brown coloured apical one third or one fourth of operculum, but apical marginal part covered with white wax.

**Abdomen.** – Brown to light brown, very occasionally with a greenish tinge. Dorsally brownish, but tibial coverings light brown with laterobasal corner dark brown, lateral parts of segment 3, and posterior one thirds of segments 3 and 4 often light brown. Segment 3 often with a patch of white wax with silvery hairs covering the lateral parts of segment and extending along anterior segment margin. Ventral side of abdomen light to dark brown.

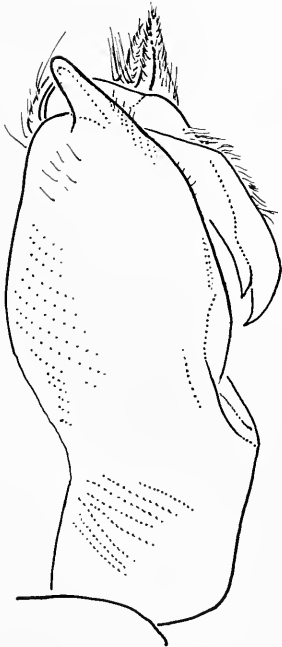
**Genitalia** (figs. 131-134). – Lateral pygofer lobes apically with either relatively long, upcurved, nipple-like, in ventral view slightly laterally curved, protrusions (found in most males from Luzon (fig. 132), Los Negros, Panay and Samar), or with weakly pointed, protrusions (found in males from Mindanao, Leyte (fig. 131) and some specimens from Luzon). Lateral sides of pygofer more or less parallel or weakly convex. Basal pygofer lobes with narrow outcurved ridges. Uncus with small, weakly globose, basal part. Uncus lobes adjacent medially, and with semicircular mediobasal corners that continue in the oblique, slightly convex, straight or slightly concave apical margins, ending laterally in a curved apical spine, while the concave lateral margins form another distinct spine just above the apical spine. Arcuate ridge between uncus lobes over apex of aedeagus weakly elevated and laterally incurved.



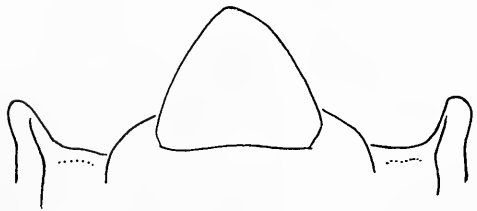
131



133



132



134

Figs. 131-134. *Orientopsaltria fuliginosa*, male. – 131, pygofer in lateral view, Philippines, Leyte, Palo; 132, pygofer in lateral view, Philippines, Luzon, Manila; 133, pygofer in ventral view, Philippines, Luzon, Mt Isarog; 134, apical part of pygofer in ventral view, Philippines, Luzon, Manila.

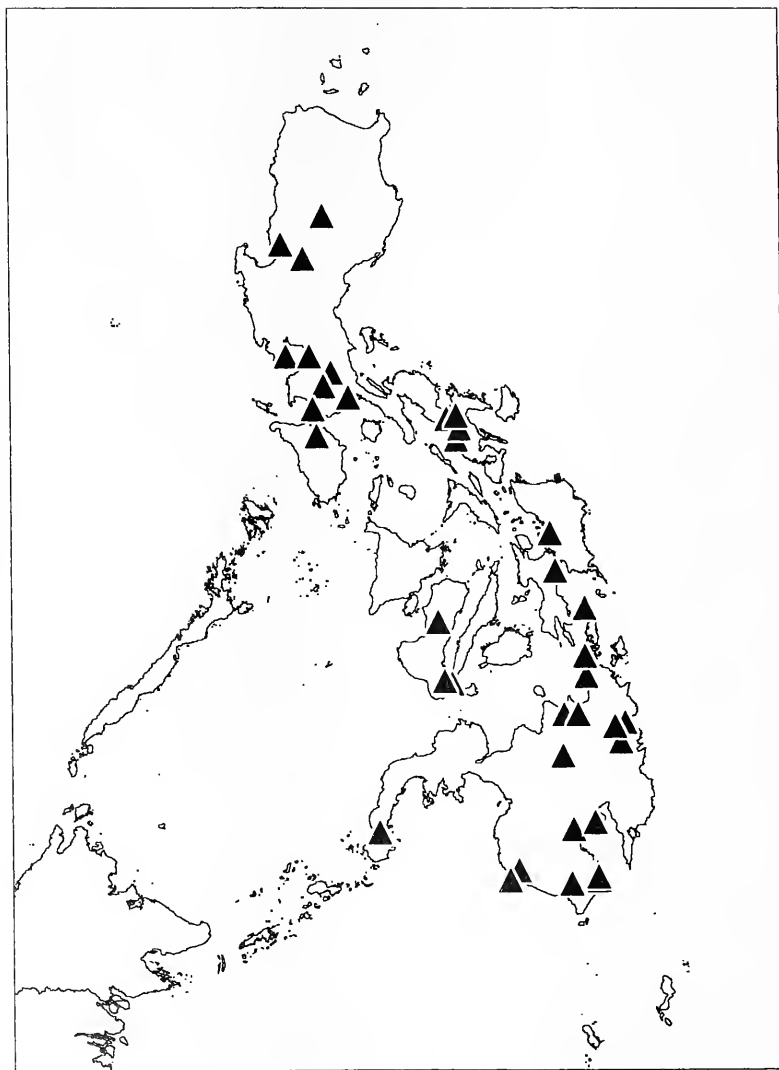
## Female

Operculum (fig. 105). – Pale ochraceous, reaching to just beyond posterior margin of abdominal segment 2 or to half-length segment 3. Lateral margin undulate; laterodistal corner of operculum rounded, and slightly protruding laterad. Posterior margin fairly strongly convex from meracanthus to laterodistal corner.

Abdomen. – Dorsally brown, segments 2-3 sometimes somewhat lighter coloured than the other segments; segments 2-4 sometimes with a pair of faint, paramedian, dark brown marks; segment 9 with a pair of paramedian, triangular, dark brown marks.

Ventrally with a dark brown medial fascia on sternite 7, and often with dark brown lines along posterior margins of sternites, and with dark lateral marks and a dark brown coloration along lower margins of segment 9.

Measurements. – Body length ♂ Luzon (n=10): 28.3-31.3 mm ( $29.4 \pm 1.1$ ), Negros (n= 5): 29.4-32.2 mm ( $30.9 \pm 1.3$ ), Mindanao (n= 5): 31.7-32.5 mm ( $32.0 \pm 0.3$ ); ♀ Luzon (n= 10): 23.4-30.1 mm ( $26.7 \pm 2.5$ ), Negros (n= 8): 25.5-29.1 mm ( $27.6 \pm 1.6$ ), Mindanao (n= 10): 27.5-32.5 mm ( $30.1 \pm 1.5$ ). Other measurements for the specimens of



Figs. 135. Distribution of *Orientopsaltria fuliginosa*.

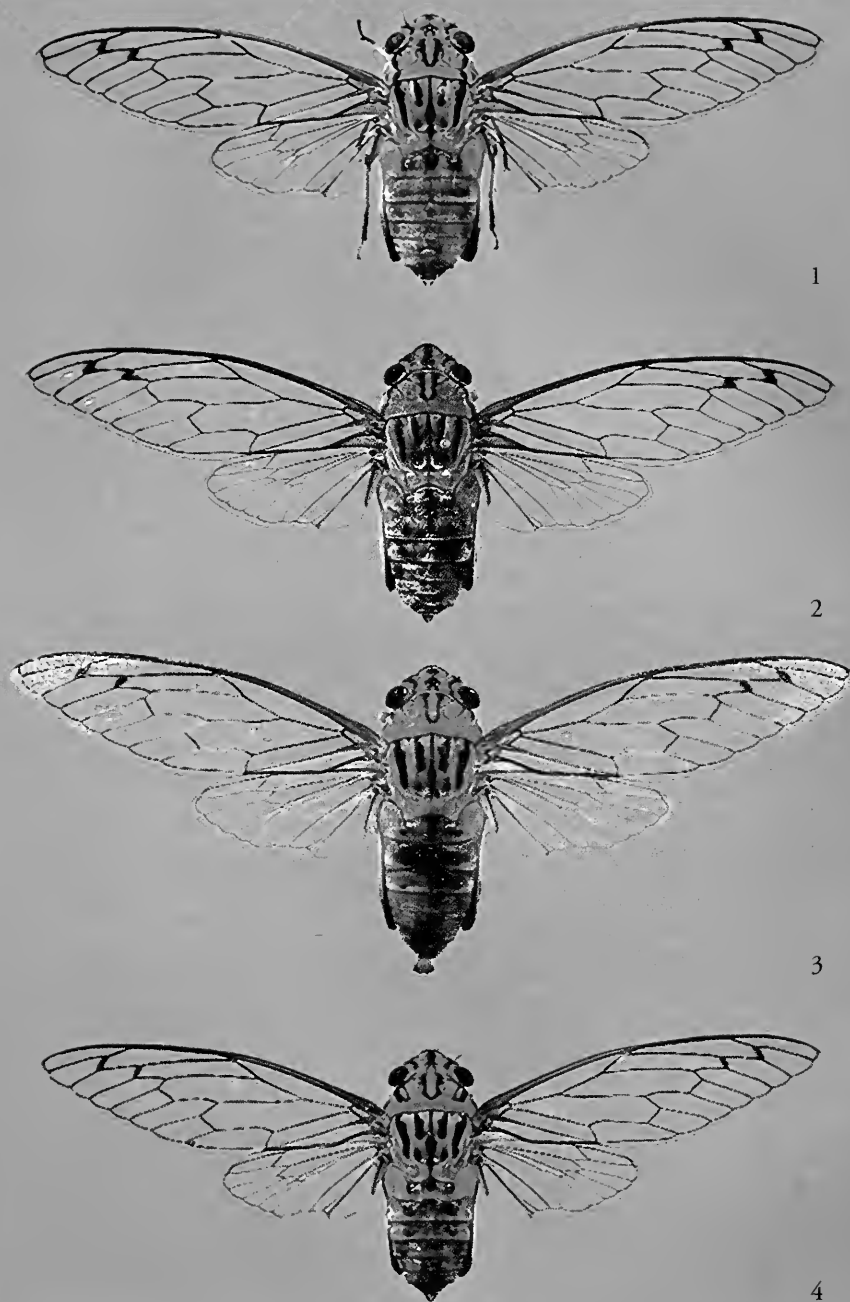


Plate 1. fig. 1. *Orientopsaltria duarum*, Sumatra, Dumai; 2. *O. padda*, Sabah, Danum Valley; 3. *O. saudarapadda*, paratype, Malacca; 4. *O. moultoni*, Sumatra, Png Pandjang.

the three islands together ( $n = 20 \sigma 28 \varphi$ ), head width  $\sigma$  8.9-11.3 mm ( $9.7 \pm 0.6$ ),  $\varphi$  9.0-11.9 mm ( $10.4 \pm 0.9$ ); pronotum width  $\sigma$  9.0-11.8 mm ( $10.0 \pm 0.7$ ),  $\varphi$  9.1-12.3 mm ( $10.8 \pm 0.9$ ); tegmen length  $\sigma$  35.5-45.2 mm ( $39.5 \pm 2.6$ ),  $\varphi$  34.7-46.0 ( $42.0 \pm 2.9$ ).

### Variability

*O. fuliginosa* is a very variable species. Attempts to distinguish between a northern form from Luzon, Los Negros, Panay and Samar, and a southern form from Mindanao and Leyte seemed to be promising but proved unsuccessful. Most males of the northern form have apical pygofer lobes with relatively long, nipple-shaped, protrusions and, in ventral view, more or less parallel lateral pygofer sides, while the males of the southern form have weakly pointed protrusions and strongly curved lateral pygofer sides. However, in a few specimens of a series from Mt Isarog and Mayoyao in Luzon the protrusions are more weakly pointed, and the lateral pygofer sides more strongly curved. Specimens from the various Philippine islands also differ in marking on head and thorax. In the Mindanao material the fasciae on the thorax are often more conspicuous and broader than in the Luzon specimens; the Luzon males and females have very narrow mesonotal fasciae. There appears to be a kind of clinal variation in average body sizes, increasing from north to south: the specimens from Luzon are small, those from Negros somewhat larger and those from Mindanao again somewhat larger (see measurements).

Material examined. — 59  $\sigma$  139  $\varphi$ . PHILIPPINES, LUZON: Asin Hot Springs: 17 km NNE of Baguio City, 800 m, 24.v.1984, R. Greenfield, Acc. 1984.291, 1  $\varphi$  (BPBM); Los Banos, B.M. 1926-89, C. F. Baker, 1  $\varphi$  (BMNH), 1  $\delta$  (SEM); Los Banos, 207, Baker, 1  $\delta$  (BMNH); Los Banos, x.1915, coll. f. Muir, 4  $\varphi$ , same data but: 1.x.1915, 1  $\varphi$ , viii.1915, 1  $\varphi$ , 10-11.1915, 1  $\varphi$ , viii.1916, 1  $\varphi$  (BPBM); Los Banos, 1  $\delta$  (BPBM); Bataan, Orion, 10.vii.1917, Distant Coll. 1911-383, 2  $\delta$  (BMNH); Bataan, Orion, 10.vii.1917, Cornell U. Lot. 441 Sub. 1, 3  $\delta$  (CUIC) 1  $\delta$  (ZMA); Bataan, Orion, vi.1901, Cornell U. Lot. 732 Sub. 14, 1  $\delta$  (CUIC); Batangas, 7.viii.1945, H.E. Milliron, 2  $\varphi$ , same data but: 8.viii.1945, 2  $\delta$ , 9.viii.1945, 2  $\delta$  3  $\varphi$  (BPBM); Imugan, 1  $\delta$  (BMNH); Camarines, Mt. Iriga, 900 m, 2.v.1962, H. Torrevillas, 1  $\varphi$  (BPBM); Camarines Sur, Mt. Isarog, 600 m, 6.iv.1965, light trap, H. M. Torrevillas, 1  $\delta$ , same data but 600-800 m, 1  $\delta$  1  $\varphi$ , 800 m, 30.iv.1965, 1  $\varphi$  (BPBM); Mt. Isarog, 750-850 m, 13-15.v.1963, H. M. Torrevillas, 1  $\delta$  2  $\varphi$ , same data but 15-17.v.1963, 1  $\varphi$ , 10-12.v.1963, 2  $\varphi$ , 8-12.v.1963, 1  $\varphi$  (BPBM); Mt. Isarog, 800-850 m, 24.iv.1963, light trap, H. M. Torrevillas, 2  $\delta$  (BPBM), same data but: 25.iv.1963, 1  $\delta$  (ZMA) 2  $\varphi$  (BPBM), 750-800 m, 1  $\varphi$  (BPBM), same data but 10-12.v.1963, 1  $\delta$  (ZMA); Mt. Isarog, 1600 m, 21-22.v.1963, H. M. Torrevillas, 1  $\delta$  3  $\varphi$  (BPBM); Mt. Isarog, Pili, 700 m, 28.iv.1963, light trap, H. M. Torrevillas, 4  $\varphi$ , same data but: 800 m, 25.iv.1965, 1  $\varphi$ , 800 m, 30.iv.1965,

1  $\varphi$  (BPBM); Mt. Isarog, 20 km E. of Naga, 500-600 m, 8.iv.1963, H. M. Torrevillas, 1  $\varphi$  (BPBM); Jalajala, coll. Noulahier, 1  $\varphi$  (MNP); Albay Province, Libon, Cagascos, 200 m, 7.v.1965, H. M. Torrevillas, 1  $\delta$  1  $\varphi$ , same data but: 18-19.v.1965, 1  $\varphi$  (BPBM); Lucena, 23.vii.1985, J. Lourens, 1  $\delta$  (ZMA); Manila, 29.vii.1985, on trees, J. Lourens, 1  $\delta$  (ZMA); Manila, 1.vi.1919, Cornell U. Lot. 732 Sub. 14, R. C. McGregor, 1  $\delta$  (CUIC); Manila, 29.vii.1985, J. Lourens, 1  $\delta$  2  $\varphi$  same data but: 27.vii.1985, 1  $\varphi$  (ZMA), 14.vii.1985, 1  $\varphi$  (ZMA); Mt. Makiling, 7475, 1916-237, Baker, 2  $\varphi$  (BMNH); Mt. Makiling, 520 H, Distant coll. 1911-383, 1  $\varphi$  (BMNH); Mt. Makiling, Baker, 1  $\delta$  (SEM); Ifugao Prov., Liwo, 8 km E Mayoyao, 1000-1300 m, 2-6.vi.1967, L. M. Torrevillas, 4  $\delta$  (BPBM) 1  $\delta$  (ZMA), same data but, 8-13.vi.1967, 1  $\delta$  1  $\varphi$  (BPBM); Ifugao, Mayoyao, 1000-1500 m, 6.vii.1966, H. M. Torrevillas, light trap, 1  $\varphi$  (BPBM). SAMAR: Samar, Catbalogan, 1  $\delta$  (BMNH); Catbalogan, coll. Dr. D. MacGillavry, 3  $\varphi$  (ZMA); MINDORO: Baco Dist., iv.1909, J. J. Mounsey, 1912-181, 14, 1  $\varphi$  (BMNH); PANAY: Panay, Distant Coll 1911-383, 1  $\delta$  (BMNH). — NEGROS: Dumaguete, C. T. Brues, 3  $\delta$  7  $\varphi$  (MCZ) 1  $\delta$  (ZMA); Negros Occ., 13.iv.1945, C. H. Spitzer, 1  $\delta$ , same data but 21.iv.1945, 1  $\delta$ , 22.iv.1945, 1  $\delta$  (CAS); Negros Oriental, Amio area, 1948, 1  $\delta$  (BPBM); L. Balinsasayao, 1-7.x.1959, C. N. Yoshimoto, 1  $\delta$ , same data but: L. Quate and C. Yoshimoto collectors, 1  $\varphi$  (BPBM); Mt. Canlaon, 2000 m, 23.v.1986, J. Lourens, swamp, 1  $\varphi$  (ZMA); Murcia, Mt. Madalagan, 2800-3200 ft, 1.ii.1988, A. Buenafe, 1  $\delta$  (RMNH); Negros Oriental, nr. Valencia, Maitre R., 28.vi.1958, H.E. Milliron, 1  $\delta$  (BPBM). — LEYTE: Palo, 23.iv.1957, 1  $\delta$  (ZMA); Palo, 19.v.1957, 1  $\delta$  (BPBM); Palo, 30.vi.1957, 1  $\delta$  (BPBM). — HOMONHON: Eastern Samar Prov., Magellanes Point, 20.v.1988, Roland A. Müller, 2  $\varphi$  (RMNH). — MINDANAO: Agusan, Esperanza, 4-11.xi.1959, C.M. Yoshimoto, 7  $\varphi$  (BPBM); Agusan, Los Arcos, 19-23.xi.1959, C.M. Yoshimoto, 1  $\varphi$ , same data but: L.W. Quate collector, 1  $\varphi$  (BPBM); Agusan, S. Francisco 10 km SE, 13.xi.1959, L. Quate & C. Yoshimoto, 1  $\varphi$  (BPBM); Mt. Apo, Sibulan Riv., 2000 ft, 11.10, C. F. Clagg, 2  $\varphi$  (MCZ); Misamis Or., Balason, 8.iv.1960, H. Torrevillas, 1  $\varphi$  (BPBM); Binatua, S. M. Weber, 1  $\varphi$  (MCZ); Calian, 29.5, C. S. Baker, 2  $\varphi$  (MCZ); Davao, 6541, Distant Coll. 1911-383, 1  $\delta$  (BMNH); Davao, C. S. Banks, 2  $\varphi$  (MCZ); Dinawihan Gingoog, 26 km E of Gingoog City, 100-300 m, 15.vii.1965, L. Torrevillas, 3  $\varphi$ , same data but: 18.vii.1965, 1  $\varphi$ , 26.vii.1965, 1  $\varphi$ , 28.vii.1965, 1  $\varphi$ , 30.vii.1965, 1  $\varphi$ , 31.vii.1965, 5  $\varphi$  (BPBM); Cotabato Prov., Gen. Santos, 14.viii.1958, light trap, H.E. Milliron, 1  $\delta$  1  $\varphi$  (BPBM) 1  $\delta$  (ZMA); Cotabato, General Santos, viii.1958, light trap, H.E. Milliron, 2  $\varphi$  (BPBM); Gingoog, 23.iii.1961, H. Torrevillas, 1  $\delta$ , same data but: 26-27.iii.1960, light trap, 2  $\varphi$  (BPBM); Lais, Davao Prov. 11.vii, Clagg coll., 1  $\varphi$  (MCZ); Lawa, Prov. Davao, 16.v, C. S. Clagg, 1  $\varphi$ , same data but: 24.iv, 1  $\varphi$ , 2.v, 1  $\varphi$  (MCZ); Bukidnon, Malaybalay Alanib, 910 m, 23.x.1959, L.W. Quate, 1  $\varphi$  (BPBM); Z. del Sur, 24 km NW of Milbuk, nr Lebak, 210-240 m, 8.viii.1958, logged area, light trap, H.E. Milliron, 3  $\varphi$  (BPBM); Z. del Sur, Milbuk, 10.viii.1958, light trap, H.E. Milliron, 2  $\varphi$ , same data but: 10.vii.1958, 1  $\varphi$  (BPBM); Z. del Sur, Milbuk, 9-10.viii.1958, H.E. Milliron, 1  $\varphi$  (BPBM); Surigao, 7  $\varphi$  (BMNH); Surigao, coll. Dr. D. MacGillavry, 3  $\varphi$  (ZMA); Surigao, L. Mainit, 25.xi-1.xii.1959, C.M. Yoshimoto, 1  $\varphi$  (BPBM); Zamboanga, 1916-234, Baker, 1  $\delta$  (BMNH); Zamboanga, gift of B. P. Clark, 16  $\varphi$  (MCZ). — BASILAN: Basilan, 2-3.1898, Doherty, ex coll. Fruhstorfer, 1  $\varphi$  (HNHMH).

***Orientopsaltria latispina* sp. n.**  
(figs. 123, 128, 136-137, plate 6 fig. 3)

Type material. – Holotype ♂: 'Lubang Phil / Islds. May', 'P. de Mesa / collector' (MCZ). – Paratypes: PHILIPPINES: LUBANG I.: Lubang, P. de Mesa, 7 ♂ 3 ♀ (MCZ) 1 ♂ 1 ♀ (ZMA). Six male and all female paratypes were preserved in alcohol before mounting and are therefore dull coloured and shrivelled.

This species is only known from one series from Lubang Island, west of the passage between Luzon and Mindoro Island (fig. 123). The species cannot be separated from the widespread *O. fuliginosa* on external features. The distinguishing characters of the new species are found in the male genitalia, viz., the weakly pointed lateral pygofer lobes (fig. 137) and, in particular, the very broad apical spine of the uncus (fig. 136). In addition to a description of the genitalic characters characterizing *O. latispina*, a short description of the external features is given below, as this species is much less variable than *O. fuliginosa*.

### Description

Ground colour brownish, sometimes with greenish tinge. Marking on head and thorax mostly black to black-brown.

Head. – Dorsally with median trefoil shaped black to black-brown, mark, which is fairly broadly connected with anterior pronotum margin and frontoclypeal suture. Other dorsal marking on head as in *fuliginosa* but oblique fasciae dark brown. Underside of vertex lobes with broad, dark brown fascia running from antenna to eye. Postclypeus as in *fuliginosa*, lower part of postclypeus with a fairly broad, light brown to black-brown median mark on lower half. Anteclypeus with lateral parts of apical half brownish or black-brown. Rostrum as in *fuliginosa*.

Thorax. – Pronotum. Paired central black fasciae fairly narrow, slightly diverging from pronotal collar to anterior margin of pronotum, strongly widened to the anterior and slightly widened to the posterior ends. A fairly large brown mark, just behind the eye, at anterior part of ambient fissure continues in a narrow brown to black-brown fascia in the lateral part of the ambient fissure and the posterior oblique fissure. Another brown mark at half-length of lateral margin of pronotal collar. A pair of brown spots between the two pair of fissures is found in some specimens only. Posterior margin of pronotal collar with very narrow, black line.

Mesonotum. – Five narrow, black fasciae. Median fascia, reaching from anterior margin of mesonotum to cruciform elevation, widens gradually to 2-3× its anterior width, and slightly narrows again toward cruciform elevation. Paramedian fasciae slightly con-

verge from anterior margin to about half-length of mesonotum. A pair of small round black spots in front of cruciform elevation, and a pair of very small, black-brown marks distally of these round spots at the end of anterior branches of cruciform elevation. Lateral fasciae reaching from one fourth of mesonotum length to nearly posterior margin of mesonotum. Distance between paramedian and lateral fasciae 2-4× as wide as lateral fasciae. A pair of small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae.

Legs. – Fore femora with subapical brown mark on inner- and outsides and a light brown to black-brown line connecting the spines along lower edge. Fore tibiae with underside and apical one fourth to one third brownish; middle tibiae with distal one fourth brown, and dark-coloured specimens with a brown spot at proximal end of upperside. Tarsi of fore and middle legs dark.

Tegmina and wings. – Hyaline. Tegmina with basal veins of 2nd and 3rd apical areas infuscated. Venation light to dark brown.

### Male

Operculum (fig. 128). – As in *fuliginosa*.

Abdomen. – As in *fuliginosa*, but patch of white wax on segment 2 absent or very indistinct, posterior margins of segments 5 and 6 light-coloured.

Genitalia. – Lateral lobes of pygofer very weakly pointed. Basal pygofer lobes with narrow outcurved ridges. Uncus with small, weakly globose, basal part. Uncus lobes adjacent medially, and with rounded mediobasal corners that continue in the weakly undulate apical margins, ending laterally in a very broad, curved apical spine, while the concave lateral margins form another very strong spine next to the apical spine. Arcuate ridge between uncus lobes over apex of aedeagus weakly elevated and laterally incurved.

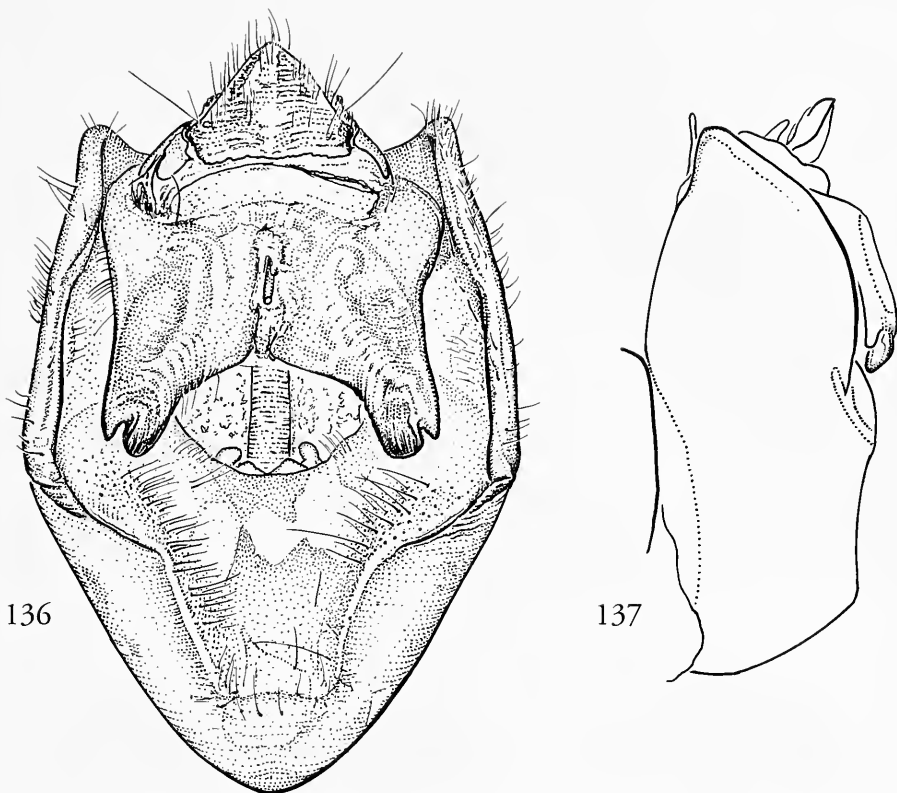
### Female

Operculum. – Pale ochraceous, reaching to one third or half-length abdominal segment 3. Lateral margin undulate; laterodistal corner of operculum rounded, and slightly protruding laterad. Posterior margin fairly strongly convex from meracanthus to laterodistal corner.

Abdomen. – Dorsally with anterior half or two-thirds of segments 2-8 brown and posterior part yellowish; segment 9 with a pair of paramedian, triangular, black-brown marks extending to three fourths of segment length. Ventrally light ochraceous with more or less distinct dark brown medial fascia on sternite 6-7, dark brown coloration on medial part of sternites 4-5, and furthermore dark brown along posterior margins of sternites 3-6 and along lower margins of segment 9.



Plate 2. — 1. *Orientopsaltria montivaga*, Sabah, Kalabakan; 2. *O. ruslani*, paratype, Peninsular Malaysia, Tanah Rata; 3. *O. agatha*, Sabah, N. of Kalabakan; 4. *O. brooksi*, Peninsular Malaysia, Kuala Rompin.



Figs. 136, 137. *Orientopsaltria latispina*, male holotype, Philippines, Lubang. – 136, pygofer in ventral view; 137, pygofer in lateral view.

Measurements (n= 6♂ 4♀). – Body length ♂ 27.5–30.5 mm, ♀ 26–27 mm; head width ♂ 9.4–9.8 mm, ♀ 9.6–10.7 mm; pronotum width ♂ 9.7–10.0 mm, ♀ 10.3–11.3 mm; tegmen length ♂ 37–38.5 mm, ♀ 38–41.5 mm.

*Orientopsaltria noonadani* sp. n.  
(figs. 106, 123, 138–147, Pl. 6 fig. 4)

Type material. – 42♂ 22♀. Holotype ♂: 'Philippines, Palawan / Brookes Point / Uring Uring, 21 august 1961, Noona Dan Exp. 61–62', 'Caught by / mercury-light / 20.00–22.00' (UZMK). – Paratypes: PHILIPPINES: PALAWAN: same data as holotype, 1♂, same data but: 18.viii.1961, 24.00–03.00, 1♂ (UZMK), 16.viii.1961, 19.00–22.00, 1♂ (ZMA); Brookes Point, Uring Uring, 17.viii.1961, Noona Dan Exp. 61–62, Caught by light from Petromax, 3♂, same data but 14.viii.1961, 14♂ 3♀, 15.viii.1961, 1♂, 17.viii.1961, 1♀, 19.viii.1961, 1♂ 1♀, 23.viii.1961, 1♂ (UZMK) 1♀ (ZMA); Brooke's Pt., Macagua, 75 m, 7.iv.1962, H. Holtmann collec-

tor Bishop, 1♂ (ZMA); 3 km NE Tinabog, 8.v.1962, H. Holtmann, 2♂ 1♀, same data but 7–8.v.1962, 1♂ 2♀, 10.v.1962, 1♀, 12.v.1962, 1♀ (BPBM); S. Palawan, 1♂ (HNHM); Palawan, Waterstradt, 1♂ (BMNH); Palawan, 1♂ 2♀ (BMNH); Palawan, coll. Noualhier 1898, 1♂ (MNP); Palawan, coll. Noualhier 1898, Distant coll. 1911–383, 1♂ (BMNH); Palawan, Distant coll. 1911–383, 1♂ (BMNH). – BALABAC: Dalawan Bay, 4.x.1961, Noona Dan Exp. 61–62, Caught by mercury-light, 19.45–23.45, 1♂ (ZMA); Dalawan Bay, 5.x.1961, Noona Dan Exp. 61–62, Caught by mercury-light, 19.30–04.00, 1♀ (UZMK) 2♀ (ZMA); Dalawan Bay, 7.x.1961, Noona Dan Exp. 61–62, Caught by mercury-light, 19.00–06.00, 3♂ 2♀ (UZMK); Dalawan Bay, 9.x.1961, Noona Dan Exp. 61–62, 1♂ (UZMK); Dalawan Bay, 9.x.1961, Noona Dan Exp. 61–62, Caught by mercury-light, 18.30–3.00, 1♀ (UZMK); Dalawan Bay, 12.x.1961, Noona Dan Exp. 61–62, Caught by mercury-light, 18.30–23.30, 1♂ 1♀ (UZMK); Balabac, Pasig, 4.iii.1957, Yoshio Kondo, 1♂ 1♀ (BPBM); Balabac Is. 10 km S. Balabac 18.iv.1962, H. Holtmann, Light

Trap, 1♂ (BPBM); Balabac Is. 10 km S. Balabac 22.iv.1962, H. Holtmann & W. Sanguila, Light Trap, 1♂ (BPBM); Balabac Is. 10 km S. Balabac 27.iv.1962, M. Thompson, 1♀ (BPBM); Balabac, 12.[18]99, Fruhstorfer, 1♂ (HNHM). Other material. – BUSUANGA: Busuanga Is., 4 km N. San Nicolas, 20.v.1962, H. Holtmann, Light Trap, 6♂, same data but 21.v.1962, 2♀, 22.v.1962, 6♀, 23.v.1962, 12♀, 24.v.1962, 24♀, 25.v.1962, 3♂ 27♀, 26.v.1962, 1♀, 28.v.1962, 23♀, 30.v.1962, 4♂ 49♀ (BPBM) 2♀ (ZMA), Dalawan Bay, 5.x.1961, Noona Dan Exp. 61-62, Caught by mercury-light, 19.30-04.00, 1♀ (UZMK), 23.v.1962, 1♂, 24.v.1962, 1♂ (ZMA); Busuanga Is., 4 km N. San Nicolas, 28.v.1962, M. Thompson, Light Trap, 2♂ (BPBM); Is. Calamianes, Malhato (I. Busuanga), A. Marche, 1885, 269 9 85, 1♂ (MNP).

*O. noonadani* is described as new from Palawan and Balabac Island, south of Palawan (fig. 123); specimens from Busuanga Island in the Calamian group, between Palawan and Mindoro, are attributed *O.*

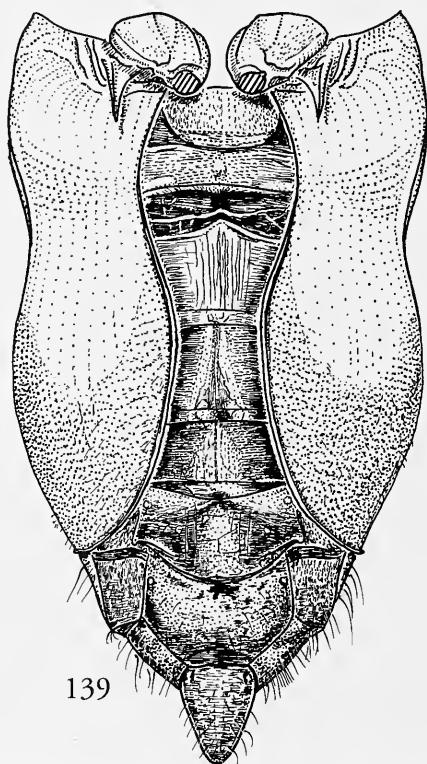
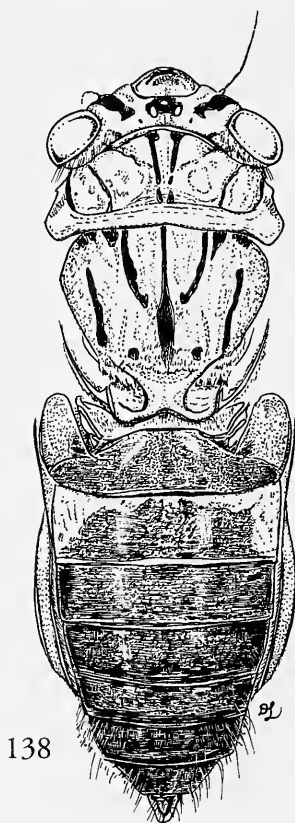
*noonadani*, but not included in the type-series, because they differ in several features from the typical specimens.

*O. noonadani* resembles *O. inermis* in the relatively large body size, the shape of the male operculum, the marking on the tegmina with spots at the bases of the 2nd, 3rd, 5th, and 7th apical areas, and small spots at the apices of longitudinal veins, but this species lacks the parallel ridges of the basal pygofer lobes (fig. 140) of *O. inermis*. The distinct upcurved nipple-like protrusions of the lateral lobes of the pygofer of *O. noonadani* (fig. 141) are more similar to those of *O. fuliginosa*. The light brown colour of the basal part of the male operculum in *O. noonadani* gradually turns to brown or dark brown in the apical part, while the male opercula of *inermis* and *fuliginosa* show a contrasting light brown basal part and dark brown apical part.

### Description

Ground colour brownish, often with greenish tinge. Marking on head and thorax mostly black.

Head. – Ocelli enclosed by brown to black, tre-

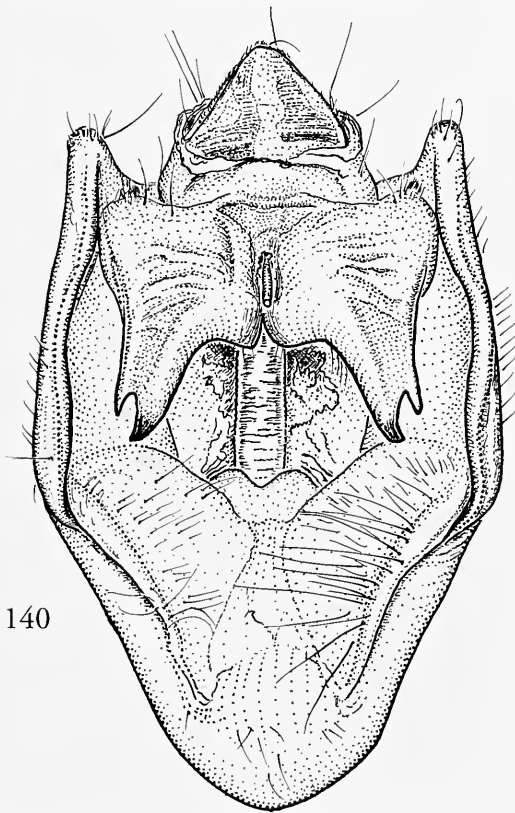


Figs. 138, 139. *Orientopsaltria noonadani*, male holotype, Philippines, Palawan, Brookes Point, Uring Uring. – 138, body in dorsal view; 139, abdomen with opercula in ventral view.

foiled mark, which is sometimes connected with anterior pronotum margin by two central brown to black lines; the trefoiled mark extends distad toward frontoclypeal suture, and in most specimens continues on the postclypeus in a faint, brownish, anchor-shaped mark touching median ground coloured oval spot on anterior part of postclypeus. Supra-antennal plates with a light to dark brown line along anterior margin. A pair of oblique, dark to light brown, broad and straight fasciae extend from vertex lobes to the level of the paired ocelli; fasciae are about equally wide along their length, and  $0.5-2\times$  as wide as distance between fascia and eye. A pair of small spots latero-proximad of paired ocelli are in a direct line with the oblique fasciae. A pair of small black triangles is situated mediad of eyes against anterior margin of pronotum. Underside of vertex lobes with dark brown fascia running from antenna to eye. Anterior part of postclypeus occasionally with only 6-7 transverse lines on either side, but most specimens have transverse lines along the whole length of the postclypeus up to the anteclypeus; the upper 3-7 lines are

black to black-brown, while the lower lines are usually lighter brownish, the upper 3 lines reach to the supra-antennal plates, the lower lines become gradually shorter; medial ends of the upper 6-7 lines connected and enclosing an oval spot of the ground colour, lower lines of both sides meet in a often fairly broad but sometimes narrow, light to dark brown median line, or occasionally in two narrow parallel brown lines which fuse toward the anteclypeus, median line or lines reaching from ground coloured oval spot to clypeal suture. Anteclypeus often with short median mark and lateral parts of the apical half brownish. Rostrum dark brown to black apically, and reaching just beyond hind coxae.

Thorax. – Pronotum. Paired central black fasciae narrow, equally wide and slightly diverging from pronotal collar to anterior margin of pronotum, distal ends triangularly widened, proximal ends only slightly widened. Anterior and posterior oblique fissures and lateral part of ambient fissure often brownish coloured, but most conspicuous in all specimens is the brownish mark against the anterior part of the



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Figs. 140, 141. *Orientopsaltria noonadani*, male holotype, Philippines, Palawan, Brookes Point, Uring Uring. – 140, pygofer in ventral view; 141, pygofer in lateral view.

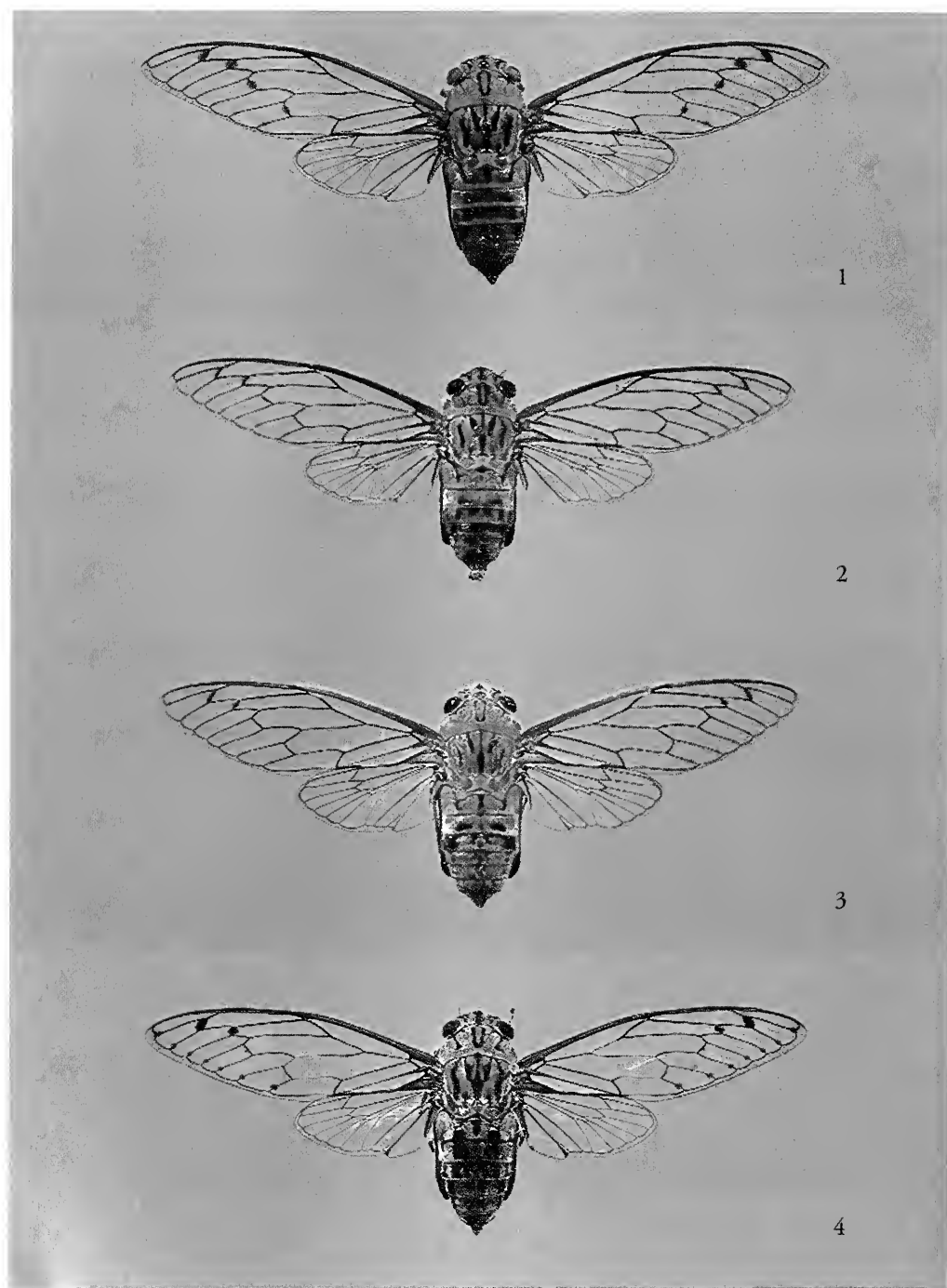


Plate 3. – 1. *Orientopsaltria angustata*, holotype, Borneo; 2. *O. guttigera*, Sumatra, T. Enim; 3. *O. phaeophila*, Sabah, Quoin Hill; 4. *O. maculosa*, paratype, Kalimantan, Long Bia.



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Plate 4. — 1. *Orientopsaltria hollowayi*, holotype, Sarawak, G. Api; 2. *O. ida*, Brunei, Temburong; 3. *O. palawana*, holotype, Palawan, Mantalingajan; 4. *O. sumatrana*, Sumatra, Atjeh.

ambient fissure just behind the eye, that continues as a brown fascia on the pronotal collar. A pair of vague spots is sometimes situated between the two pair of fissures. Posterior margin of pronotal collar with very narrow, black line.

Mesonotum. — Five very narrow, black fasciae. Median fascia reaching from anterior margin of mesonotum to cruciform elevation, anteriorly very narrow, widening to 2-3 $\times$  its anterior width at two fifths of its length from base, and slightly narrowing again toward cruciform elevation. Paramedian fasciae equally narrow and slightly converging from anterior margin to about half-length of mesonotum; posterior ends slightly recurved. A pair of small round black spots in front of cruciform elevation, and a pair of black marks distally of these round spots at the end of anterior branches of cruciform elevation. Lateral fasciae reaching from one fourth of mesonotum length to nearly posterior margin of mesonotum. Distance between paramedian and lateral fasciae 4-8 $\times$  as wide as

lateral fasciae. A pair of small, black triangles at anterior margin of mesonotum laterally of paramedian fasciae.

Legs. — Fore femora with subapical brown marks on inner- and outsides and a black-brown line connecting the spines along lower edge; middle and hind femora often with brown fascia on inner sides. Fore tibiae with brownish underside; distal part of middle tibiae brown. Tarsi of fore and middle legs brown.

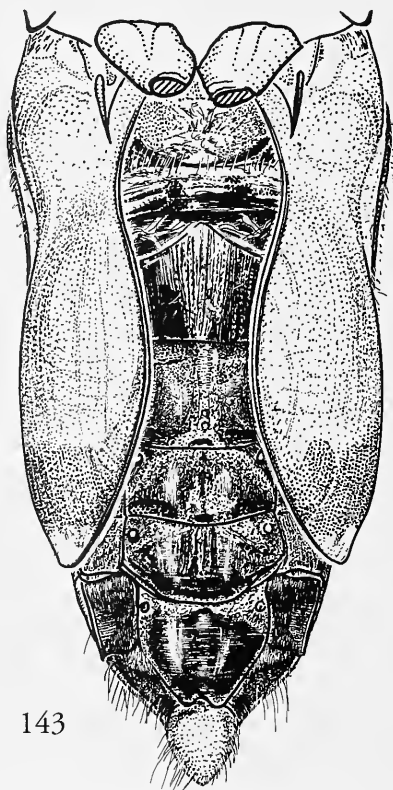
Tegmina and wings. — Hyaline. Tegmina with basal veins of 2nd and 3rd apical areas distinctly infuscated, and those of 5th and 7th apical areas less to very weakly infuscated; apices of longitudinal veins weakly infuscated. Venation light to dark brown.

#### Male

Operculum (figs. 139, 146). — Slightly outcurved, reaching just beyond hind margin of abdominal segment 5 to hind margin of segment 6. Medial margin evenly convex. Lateral margin convex in basal part, concavely sinuate at one fourth to one third of its

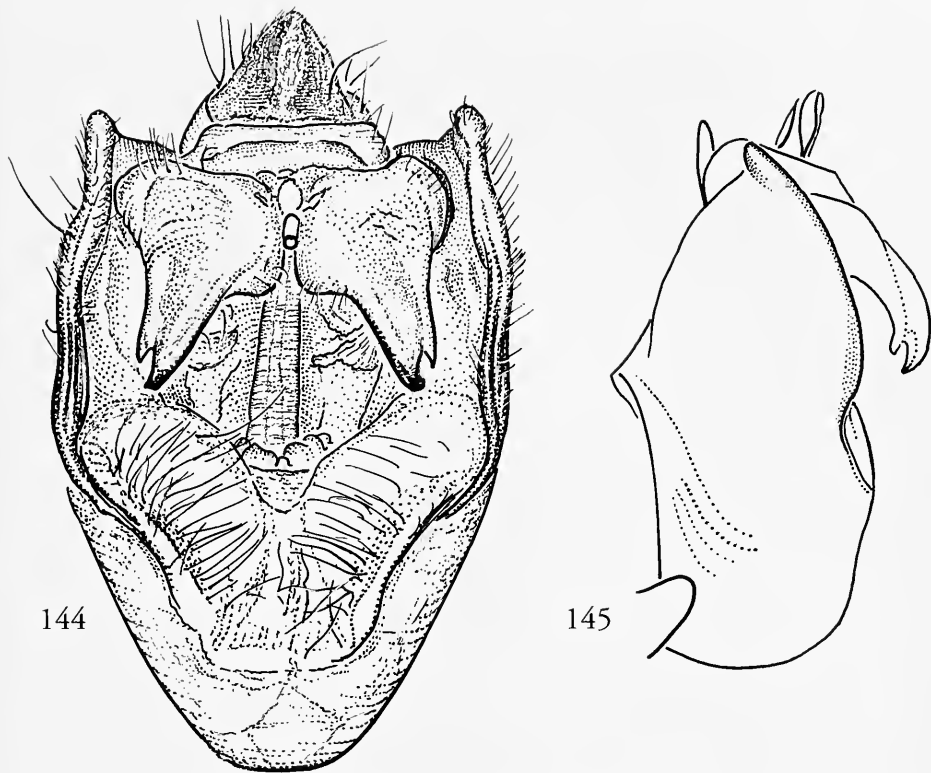


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Figs. 142, 143. *Orientopsaltria noonadani*, male, Busuanga Is., 4 km N. San Nicolas. — 142, body in dorsal view; 143, abdomen with opercula in ventral view.



Figs. 144, 145. *Orientopsaltria noonadani*, Busuanga Is., 4 km N. San Nicolas. – 144, pygofer in ventral view; 145, pygofer in lateral view.

length from base, and fairly strongly convex in apical two thirds. Basal half or two thirds of operculum ochraceous to light brown and often gradually turning to brown or dark brown in apical part of operculum, but in some specimens the dark brown apical part contrasts with the light brown basal coloration. Extreme apical margin of operculum white with silvery hairs.

Abdomen. – Abdomen dorsally brown to dark brown, but occasionally tibial coverings ochraceous, and segment 2 ochraceous with a pair of paramedian transverse brown marks. Segment 3 with a conspicuous patch of white wax with silvery hairs covering lateral parts of segment and extending along anterior segment margin to almost the middle of the segment. Ventral surface of abdomen uniformly brownish.

Genitalia (figs. 140-141). – Lateral lobes of pygofer apically with distinct upcurved nipple-like protrusions, which are in ventral view laterally curved. Basal pygofer lobes with narrow outcurved ridges. Uncus with small, weakly globose, basal part. Uncus lobes adjacent with rounded mediobasal corners that continue

in the oblique, weakly undulate apical margins, ending laterally in a strong, laterally curved apical spine, while the straight or weakly concave lateral margins form a short lateral spine just above the apical spine. Arcuate ridge between uncus lobes over apex of aedeagus weakly elevated and laterally incurved.

#### Female

Operculum (fig. 106). – Pale ochraceous, reaching to just beyond posterior margin of abdominal segment 2 or to almost half-length segment 3. Lateral margin very weakly undulate; laterodistal corner of operculum obtuse and rounded. Posterior margin almost straight and fairly strongly convex to meracanthus.

Abdomen. – Dorsally brown, segments 2-3 sometimes somewhat lighter coloured than the other segments and sometimes with a pair of faint, paramedian, dark-brown marks; segment 9 with a pair of paramedian, triangular, black-brown marks. Ventrally often with dark brown coloration along posterior margins of the sternites and along lower margins of segment 9.

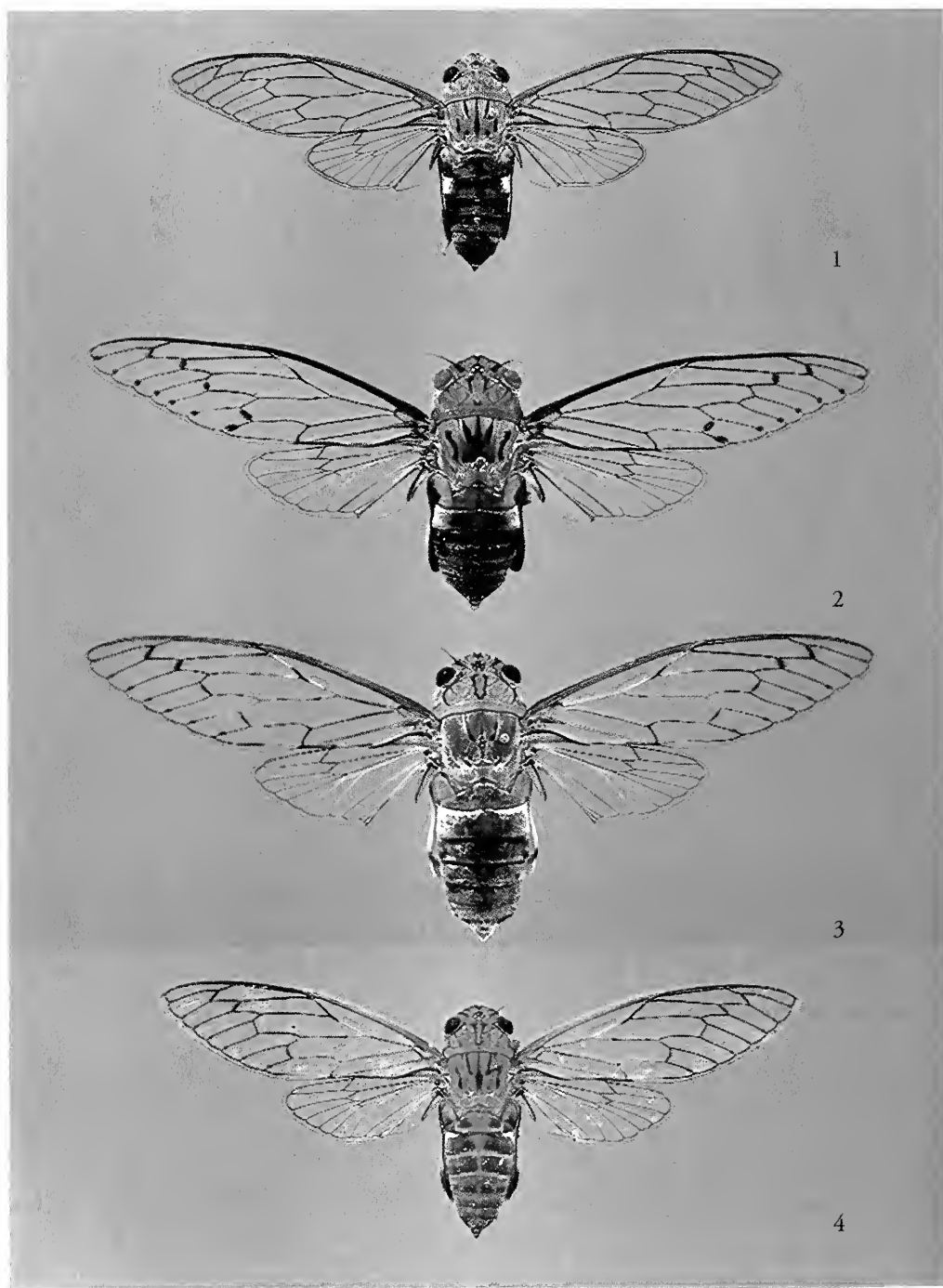


Plate 5. – 1. *Orientopsaltria vanbreei*, paratype, Peninsular Malaysia, Pasoh; 2. *O. kinabaluana*, paratype, Sabah, Mt Kinabalu; 3. *O. alticola*, Sabah, Danum Valley; 4. *O. inermis*, Mindanao, Mt Apo.



1



2



3



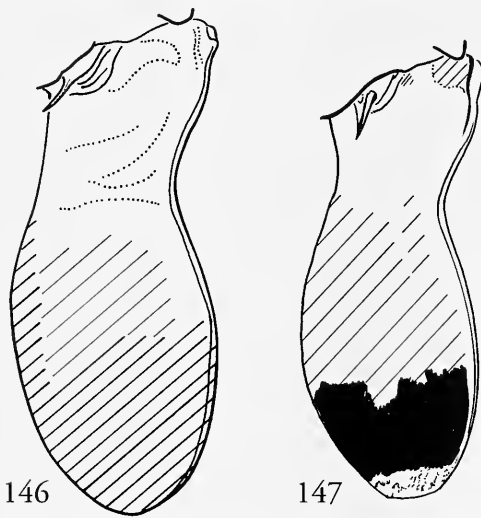
4

Plate 6. — 1. *Orientopsaltria confluens*, holotype, Basilan I.; 2. *O. fuliginosa*, Negros I., Dumaguete; 3. *O. latispina*, paratype, Lubang I.; 4. *O. noonadani*, holotype, Palawan, Brookes Point.

Measurements ( $n = 8\sigma$   $8\varphi$ ). – Body length  $\sigma$  30–35.5 mm,  $\varphi$  26–28.5 mm; head width  $\sigma$  9.2–11.0 mm,  $\varphi$  9.7–11.0 mm; pronotum width  $\sigma$  9.2–11.3 mm,  $\varphi$  10.1–11.0 mm; tegmen length  $\sigma$  34.5–42 mm,  $\varphi$  38–42 mm.

### Variability

The Busuanga specimens are not included in the



Figs. 146, 147. *Orientopsaltria noonadani*, male opercula in lateroventral view. – 146, holotype, Philippines, Palawan, Brookes Point, Uring Uring; 147, Busuanga Is., 4 km N. San Nicolas.

type series and differ from the types in the following features: Postclypeus with distinct, broad, brown to black-brown median line running from ground coloured oval spot to anteclypeus. Mesonotal fasciae broad, with distance between paramedian and lateral fascia 1.5–4× as wide as the lateral fasciae (the distance is 4–8× as wide as the fascia in the type series) (fig. 142). Distal part of male operculum in some specimens more dark brown apically, while the white waxy apical marginal part is larger than in *noonadani* (figs. 143, 147). Male genitalia as in the type-series.

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## BOOK REVIEWS

P. Huemer & O. Karsholt, 1999. Gelechiidae I (Gelechiinae: Teleiodini, Gelechini). – *Microlepidoptera of Europe* 3: 1-356, 14 colour plates. Apollo Books, Stenstrup. Hardback [ISBN 87-88757-25-0]. Price DKK 500 excl. p.&p.

Despite the fact that the biodiversity of Europe is better known and described than for most other parts of the world, there are still groups where identification is almost impossible by the lack of modern reviews. The large microlepidopteran family Gelechiidae is such a group, or I must say, was amongst those. Peter Huemer and Ole Karsholt have made a big step forward in describing the diversity of this family and making the knowledge available to a larger public than the pure experts. As the authors write, 'a complete review ... had never been undertaken...', and despite the fact that many Gelechiidae are colourful and not very small moths, no one dared to tackle this family previously. This third volume in the series *Microlepidoptera of Europe* is therefore an important addition to the series, despite the fact that the 151 species covered (including 10 new ones), form less than a quart of all European Gelechiidae.

The descriptions follow the lay-out we know already from the previous volumes, but the most striking part in this volume is formed by the excellent black and white photographs of meticulously prepared genitalia, according to the modern unrolling technique. Alone making these preparations must have cost an enormous amount of the time of the authors. These sharp illustrations prove that drawings can be replaced by good photographs. The colour photographs are sharp and in good colour and show the moths enlarged to an unknown scale. Numbering of plates and figures is somewhat unusual, but using species numbers throughout is practical when one gets used to it.

The graphical design of the series, despite some improvement, remains a weak point: the very professional contents deserves better than the sometimes rather amateurish design. A bad example is the mounting of the colour plates: the moths touch the margins and of some the wings are even cut at the tips. It is also a pity that the mounting blocks are visible. Otherwise, the printing quality of colour plates and black and white photographs is of high standard.

Despite this somewhat subjective criticism, I would like to congratulate editors and authors with a remarkable book, which I highly recommend to every microlepidopterist.

[E.J. van Nieukerken]

C.M. Naumann, G.M. Tarmann & W.G. Tremewan. 1999. The Western Palaearctic Zygaenidae. – Apollo Books, Stenstrup, 289 pp, 12 colour plates. Hardback [ISBN 87-88757-15-3]. Price DKK 600 excl. p.&p.

The Zygaenidae are amongst the more popular groups of moths, since they are brightly coloured day-flying species, and have been aptly nick-named 'honorary butterflies', as the authors cite in their foreword. The special biology of these insects, their poor dispersal powers and, hence great diversification into many local forms, make these moths excellent objects for various types of research. This book, written by three well-known specialists, reviews much of the research in extensive introductory chapters, and provides a complete treatment of the 116 species, with excellent colour plates. Apart from mounted moths, also living moths, caterpillars and habitats are shown.

The book is attractive, well-printed and definitely better designed than the book reviewed above, published also by Apollo Books.

Because of the concise treatment of all aspects of biology, including chemical defence, structures, phylogeny and conservation, this book is more than just a book on Zygaenids: it should be in the book-case of every serious lepidopterist.

[E.J. van Nieukerken]

Theo Zeegers & Ton van Haaren, 2000. Dazen en dazenlarven. Inleiding tot en tabellen voor de Tabanidae (Diptera) van Nederland en België. – Wetenschappelijke Mededelingen KNNV 225, 113 pp., illustrated. Soft cover. [ISBN 90-5011-131-9]. Price NLG 30 excl. p.&p.

[Horseflies and their larvae: introduction and keys for the Tabanidae in the Netherlands and Belgium, in Dutch].

This booklet treats the horseflies of the Netherlands and Belgium. The key includes all 57 species from these countries and the surrounding area. The key is accompanied by nice, simple pencil drawings of details. Further there is a whole chapter on larvae with a key, a rather unusual attribute of Dipteran keys. Although this key is largely based on foreign literature, it is a most useful addition and makes the book much more practical. The book is written in Dutch with a short summary in English.

This is the first volume in the series *Wetenschappelijke Mededelingen* with a complete new design, making it much more attractive than the previous volumes.

[E.J. van Nieukerken]

# GONDWANAN NEPTICULIDAE (LEPIDOPTERA)? SYSTEMATICS AND BIOLOGY OF THE *ECTOEDEmia (FOMORIA) VANNIFERA* GROUP

Hoare, R. J. B., 2000. Gondwanan Nepticulidae (Lepidoptera)? Systematics and biology of the *Ectoedemia (Fomoria) vannifera* (Meyrick) group. – Tijdschrift voor Entomologie 142 (1999): 299-316, figs. 1-39, table 1. [ISSN 0040-7496]. Published 11 April 2000.

The *Ectoedemia (Fomoria) vannifera* species-group is reviewed. Three species are recognized from South Africa (*E. vannifera* (Meyrick), *E. fuscata* (Janse) and *E. hobohmi* (Janse)), one from central Asia (*E. asiatica* (Puplesis)), and one from India (*E. glycystrata* (Meyrick) comb. n., here redescribed); three new species are described and named from Australia (*E. pelops* sp. n., *E. squamibunda* sp. n., and *E. hadronycha* sp. n.). All species share a striking synapomorphy in the male genitalia: a pin-cushion-like lobe at the apex of the valva. Two of the Australian species and one of the South African species have been reared from larvae mining the leaves of Brassicaceae *sensu lato*. A phylogeny of all currently recognized species is presented: this taken together with known distribution suggests either that the group is very ancient and antedates the split between the African and Indian parts of Gondwana (ca. 120 million years ago), or that it has dispersed more recently and has been overlooked in large parts of its range.

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Key words. – Lepidoptera; Nepticulidae; *Ectoedemia*; *Fomoria*; new species; phylogeny; biogeography; Gondwana; host-plants; Brassicaceae; Capparaceae.

The Nepticulidae constitute one of the more ancient families of Lepidoptera. On the basis of the very wide distribution of many genera and subgenera (e.g. *Stigmella* Schrank, which is known from all continents except Antarctica), and the unlikelihood of successful inter-continental dispersal by moths which show such a high degree of monophagy, Scoble (1983) postulated that the family originated before the break-up of Pangaea into Laurasia and Gondwana, i.e. 150 to 180 million years ago. Although very few lepidopteran, and no nepticulid fossils are known from the Jurassic, such an early date has recently been corroborated by the discovery of leaf-mines from the middle Cretaceous (97 million years BP) of North America (Labandeira et al. 1994). At least one of these mines can be unambiguously assigned to a modern subgenus (*Ectoedemia* Busck subgenus *Ectoedemia*), and even shares the host-plant superfamily of its closest present-day relatives. It is clear that the Nepticulidae had already undergone a considerable period of evolution by this date.

In a group of such age and presumed low dispersal ability, one would expect to be able to detect vicariance patterns among the faunas of different landmasses caused by the break-up of the continents dur-

ing the late Mesozoic and early Tertiary. The history of the break-up of the great southern continent of Gondwana is now well documented (e.g. Owen 1981, Scotese et al. 1988) and cladistic relationships congruent with this history have been demonstrated in other groups of insects of comparable age (for example Chironomidae (Diptera): Brundin 1966; Ephemeroptera: Edmunds 1975). However, as is true of so many groups, knowledge of the southern hemisphere nepticulid fauna is in its infancy compared to that of the northern hemisphere. Apart from the revision of the New Zealand Nepticulidae by Donner & Wilkinson (1989), the works of Vári (1955, 1963) and Scoble (see references in Hoare et al. 1997) on the South African fauna remain, taken together, the only comprehensive review of a southern hemisphere fauna. Nothing has been published on the South American fauna apart from a few scattered species descriptions (Zeller 1877, Meyrick 1915, 1931, Bourquin 1961) and a very brief review of known host-plant associations (Nielsen 1985). Only 19 species have so far been described from Australia (see Hoare et al. 1997; Hoare in press), and only two from South-east Asia. It is perhaps therefore not surprising that no group of Nepticulidae has

been shown to have a classical disjunct 'Gondwanan' type of distribution.

The Australian nepticulid fauna is dominated by numerous (mainly undescribed) species of Pectinivalvinae (mostly belonging to *Pectinivalva* Scoble) and of *Stigmella* Schrank (Nepticulinae: Nepticulini), and these are the only two groups recorded from this country in the literature (Common 1990, Nielsen 1996, Hoare et al. 1997; Hoare in press). During the course of a study of the systematics of Australian Nepticulidae, three genera belonging to the tribe Trifurculini were found to be present in Australia: *Acalyptris* Meyrick, *Trifurcula* Zeller (subgenus *Glaucocolepis* Braun) and *Ectoedemia* Busck. In this paper, I define and describe the *Ectoedemia* (*Fomoria*) *vannifera* group, and review it from a phylogenetic perspective. The discovery of this group in Australia, from where three new species are here described, opens up the possibility that this is an ancient Gondwanan group: this is discussed with respect to the phylogenetic hypothesis presented.

#### MATERIALS AND METHODS

Slides were prepared following the methods described by Hoare (in press). In preparing the male genitalia, one valva was usually removed and mounted dorsum uppermost in order to display the complex structures exhibited in this species group.

Cladistic analysis was performed using the computer program PAUP 3.1.1 (Swofford 1995). The data set was small enough to allow an exhaustive search to be performed; i.e. all possible tree topologies were evaluated. The program MacClade 3.06 (Maddison & Maddison 1996) was used to examine further the most parsimonious trees found by PAUP. The 'Trace Character' option was used to investigate state changes on trees character by character, and to generate the list of apomorphies. Where a character state is equivocal along a branch or part of a branch, this is clearly shown with this option in effect; it is thus possible to distinguish between unambiguous apomorphies, and those which depend on one of two or more possible character state mappings. Where alternative interpretations are possible, I have indicated this in the text.

All material of the three new species described here is deposited in the ANIC (Australian National Insect Collection, CSIRO Entomology, Canberra, A.C.T.). For other material examined (see Appendix), the following abbreviations for institutions have been used: BMNH British Museum (Natural History), London, U.K.

RMNH Nationaal Natuurhistorisch Museum, Leiden, The Netherlands.

NZAC New Zealand Arthropod Collection, Landcare

Research, Auckland, New Zealand.

TM Transvaal Museum, Pretoria, South Africa.

#### TAXONOMY

##### *The Ectoedemia (Fomoria) vannifera group*

Adults. – Head capsule (figs 2, 3): see under *E. (F.) squamibunda* sp. n. Frontal tuft either pale ochreous more or less mixed with fuscous, or black. Thorax and forewing pale ochreous with varying pattern of fuscous or blackish scales. Hindwing with or without androconia in male. Underside of male forewing sometimes with hair-pencil and/or patch of androconial scales.

Male genitalia (figs 5-17). – Vinculum with moderately long anterior extension. Tegumen not or only slightly extended into pseuduncus. Uncus inverted Y-shaped or nipple-shaped. Gnathos sometimes enlarged. Valvae widely separated at base, and vinculum extended into a membranous lobe between them. Valva (figs 6, 9, 13, 15) complex: apex with membranous pin-cushion-like lobe, dorsal surface with various projections, each bearing a seta, or with a setose 'ridge', inner (medial) edge often with well-sclerotized projection. Transverse bar of transtilla very long. Aedeagus (figs 7, 11, 16, 17): apex with paired more or less claw-like carinate processes; vesica with numerous cornuti in 1 or 2 rows.

Female genitalia (figs 18, 19). – Vestibulum usually with complex sclerites of irregular shape. Corpus bursae elongate, with well-developed signa reticulata (reticulations modified in *E. (F.) vannifera*: see Scoble 1983: fig. 117).

Larva (description based on Australian species only). – Head-capsule (figs 20-25) elongate or squarish; labial palpi 2-segmented, segment 2 ca. 2 times as long as segment 1; stipes with 1 seta. Thorax: prothoracic sternite (figs 27, 28) more or less T- or X-shaped; chaetotaxy (fig. 26): prothorax with 12 pairs of setae (one seta in XD-SD group absent, here interpreted as SD2); mesothorax with 9 or 10 pairs of setae (1 D seta present; L3 absent). Abdomen: A1-8 with 6 pairs of setae; A9 with 2 pairs of setae; A10 with 2 pairs of ventral setae, one very short, one long. Anal rods tapered, pointed. Colour yellowish; cuticular spines minute, and reduced in extent.

Pupa (description based on Australian species only). – Head: clypeus transverse; frons without setae; labial palpi slightly longer than maxillae. A2-8 dorsally with 3-4 rows of large spines on each segment; numerous minute spines anterior and posterior to these on each segment, the anterior ones arranged into small pectinations; dorsal abdominal setae absent.

Biology. – Host-plants: *Capparis* L. spp. and *Boscia* Lam. spp. (Brassicaceae). Mine (figs 29, 30): linear; exit-hole a semicircular slit.



Fig. 1. Known distribution of the *Ectoedemia* (*Fomoria*) *vannifera* group. — Triangles: *E. (F.) vannifera*; star (Abachaub, Namibia): *E. (F.) fuscata*, *E. (F.) hobohmi* and *E. (F.) vannifera*; diamond: *E. (F.) asiatica*; square: *E. (F.) glycystrata*; crossed circle: *E. (F.) squamibunda* and *E. (F.) hadronycha*; filled circle: *E. (F.) pelops*.

**Diagnosis.** — Species can only with certainty be recognized as belonging to this group on the basis of the male genitalia. The presence of the pin-cushion lobe at the apex of the valva is diagnostic; all known species also have a ridge or projection on the dorsal surface of the valva which usually bears more or less conspicuous setae.

**Distribution** (fig. 1). — South Africa (3 or 4 species), India (1 species), central Asia (1 species), Australia (4 species).

**Included species.** — The known described species belonging to the *E. (F.) vannifera* group are as follows: *Ectoedemia* (*Fomoria*) *vannifera* (Meyrick), South Africa; *E. (F.) fuscata* (Janse), South Africa; *E. (F.) hobohmi* (Janse), South Africa; *E. (F.) asiatica* (Puplesis), Central Asia; *E. (F.) glycystrata* (Meyrick), comb. n., India; *E. (F.) pelops* sp. n., Australia; *E. (F.) squamibunda* sp. n., Australia; *E. (F.) hadronycha* sp. n., Australia.

In addition, one undescribed species is known from South Africa, and one from Australia, as follows: Scoble (1983: 38) mentions a male paralectotype of

*E. (F.) hobohmi*, which shows characters intermediate between that species and *E. (F.) vannifera*, and probably represents an undescribed species. The undescribed Australian species is dealt with under *E. (F.) pelops*, q.v.

The South African species were redescribed by Scoble (1983), and *E. (F.) asiatica* has been recently redescribed and illustrated by Puplesis (1994). *E. (F.) glycystrata* is here redescribed, and the adult and male genitalia are illustrated for the first time. The new Australian species are described and illustrated.

It should be noted that Puplesis et al. (1996) erected a '*Fomoria asiatica* group': apart from *E. (F.) asiatica*, all species included in this group by these authors lack the pin-cushion lobe, and the group was not defined. Although it is undesirable to create a confusion of overlapping species-group concepts in the literature, I propose that the clearly monophyletic *vannifera* group as defined here is a biologically more meaningful entity than the *asiatica* group of Puplesis et al. (1996) and should be adopted in preference.

*Ectoedemia (Fomoria) glycystrota* comb. n.*Nepticula glycystrota* Meyrick, 1928: 462.

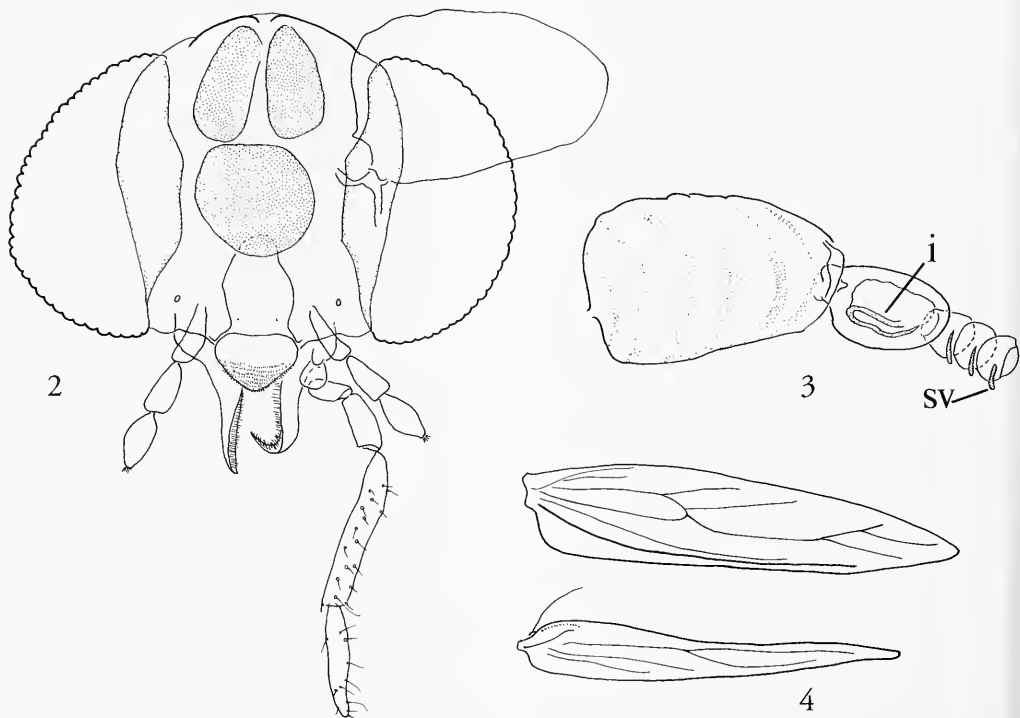
Material examined. — Lectotype (here designated) ♂, INDIA: Bombay, Kaira, 19 Mar 1925, R. Maxwell. Genitalia slide 24108 (BMNH).

Male (fig. 31). — Wingspan 4.8 mm. Head: Frontal tuft whitish ochreous, with admixture of fuscous scales; collar whitish; eyecaps whitish ochreous with a few fuscous scales towards base; antennae light grey, 52 segments. Thorax and forewing pale ochreous, irrorated with fuscous scales, except for a narrow whitish ochreous strip along dorsum; cilia whitish ochreous. Hindwing whitish; cilia whitish. Under-side: forewing shining greyish ochreous, with patch of white granular androconial scales in basal ½ in centre; overlapping this patch a row of long shining pale grey scales arising from base of hindwing costa; rest of hindwing and cilia shining whitish.

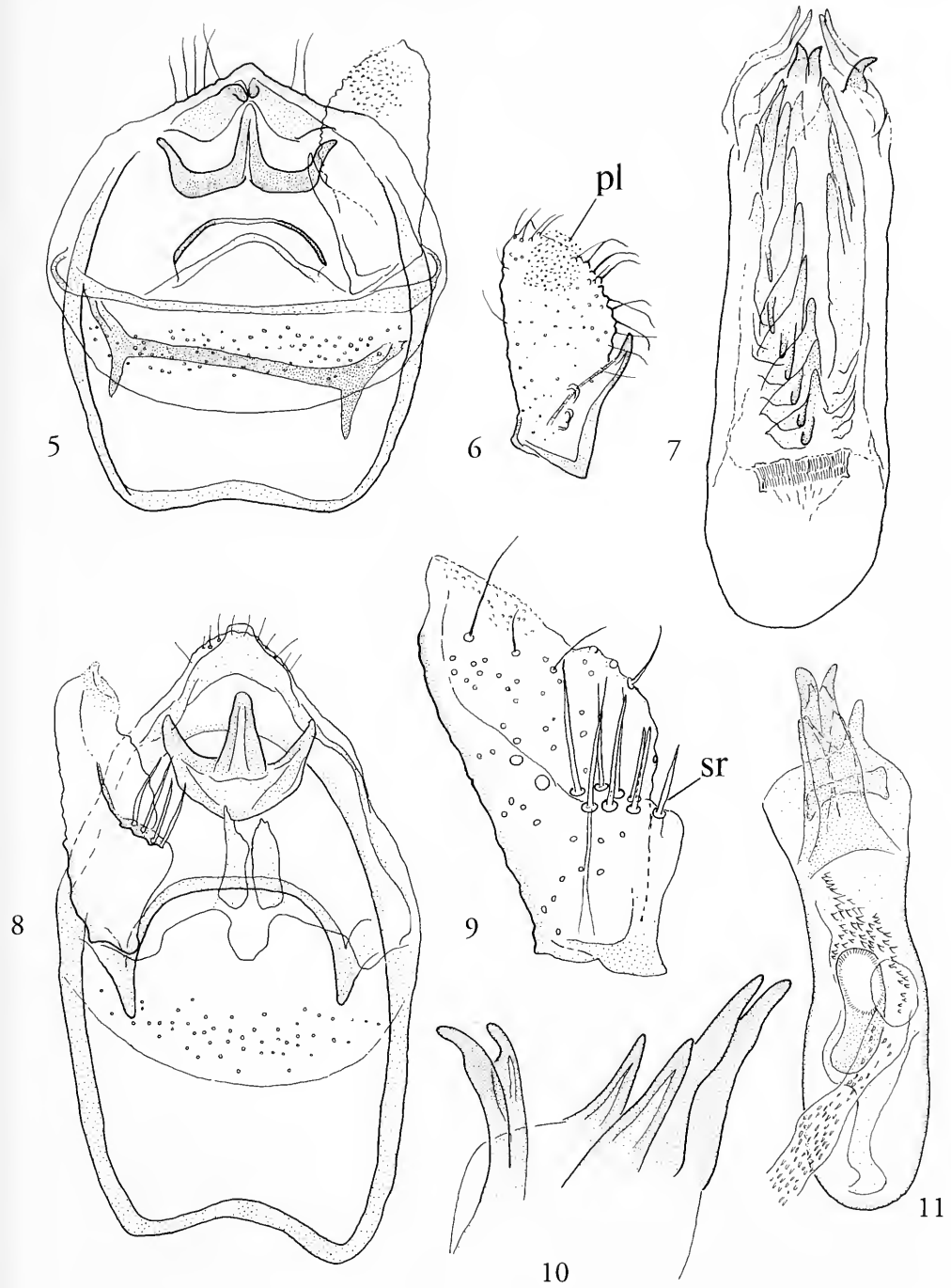
Male genitalia (figs 5-7). — Genital capsule ca. 435 µm long. Anterior extension of vinculum about ½ length of capsule, squared off; posterior edge with juxta-like lobe short and broad, sclerotized along each

side. Tegumen produced into bluntly pointed pseuduncus, a row of ca. 8 setae on each side. Uncus inverted V-shaped, weakly divided medially. Gnathos simple, W-shaped. Valva (fig. 6) reaching just beyond uncus, more or less rounded, terminating in a small blunt projection; inner (medial) edge with short spine-like process arising from about ½ way up and projecting slightly dorsally into capsule; dorsal surface with 2 or 3 small projections near base (no setae observed, but these may have been detached); pin-cushion lobe large but not projecting as far from body of valva as in other members of the group. Aedeagus (fig. 7) ca. 600 µm long, with 2 pairs of lateral carinate processes, one pair of central carinae, and a single curved carina on right in ventral view; vesica with 2 parallel fields of strong cornuti.

Remarks. — A superficial examination of a female paralectotype of *E. (F.) glycystrota* showed that it had a collar consisting of lamellate scales, and was therefore referable to the genus *Stigmella* Schrank or possibly *Acalyptis* Meyrick, but certainly not to *Ectoedemia*. The third specimen in the type series has not been examined by me, but it is a male (K. R. Tuck, pers. comm.). The larva and biology of *E. glycystrota* are unknown.



Figs 2-4. *Ectoedemia (Fomoria) squamibunda*. — 2, head (denuded), anterior view; 3, base of antenna, anterior view; 4, wing venation. i = pocket-like invagination of pedicel; sv = sensillum vesiculocladum.



Figs 5-11. *Ectoedemia (Fomoria)* spp., male genitalia. — 5-7, *E. (F.) glycystrata*: 5, genital capsule, ventral view; 6, left valva, ventral view; 7, aedeagus, ventral view. 8-11, *E. (F.) pelops*: 8, genital capsule, ventral view; 9, right valva, dorsal view; 10, tip of aedeagus, lateral view, with ventral carinae to right; 11, aedeagus, ventral view. pl = pin-cushion lobe; sr = setose ridge of valva.

*Ectoedemia (Fomoria) pelops* sp. nov.

Material examined. – Holotype, ♂, AUSTRALIA: New South Wales, 70 miles [113 km] N. of Bourke, 24 Oct 1957, I. F. B. Common. Genitalia slide 11532 (ANIC). – Paratypes, 3♂, same data as holotype. Genitalia slides 12092, 12098, 12099 (ANIC).

Male (fig. 32). – Wingspan 4.4–5.2 mm. Head: frontal tuft black; collar lead-grey; eyecaps white with a few fuscous scales; antennae grey, ca. 42 segments. Thorax and tegulae whitish ochreous. Forewing whitish ochreous, more or less heavily irrorated with fuscous; basal 1/3 of wing blackish towards costa; a conspicuous patch of raised blackish and whitish ochreous scales at base of costa; cilia whitish grey. Hindwing whitish grey; cilia whitish grey. Underside: forewing greyish, yellowish around base of cilia; hindwing pale greyish with a few blackish scales in basal 1/3. Abdomen pale silvery grey, with a patch of blackish scales on each side at base.

Female. – Not positively associated (see under Remarks).

Male genitalia (figs 8–11). – Genital capsule ca. 400 µm long. Anterior extension of vinculum long, with slight medial excavation. Tegumen rounded, with ca. 5 setae on each side. Uncus more or less teardrop-shaped, reaching just beyond tegumen. Gnathos not enlarged, basal plate relatively broad, central element a narrow triangle. Valva (fig. 9) with base of inner (mesal) edge thickened, extended laterally into a ridge, approximately 1/2 way up dorsal surface of valva; the ridge surmounted by 8 strong spine-like setae in two parallel rows; main body of valva rounded, pin-cushion lobe prominent. Aedeagus (figs 10, 11) ca. 420 µm long, relatively broad, somewhat constricted medially; one pair of dorsal, one pair of medial and one pair of ventral carinae. Vesica with numerous very small cornuti near base of ejaculatory duct, and a transverse subrectangular sclerite near apex of aedeagus.

Larva and biology unknown. The host-plant is likely to be *Capparis mitchellii* Lindley (Brassicaceae), which is common in the area where the moths were taken.

Diagnosis. – Easily distinguished from the other known Australian species by the smaller size and the absence of the black costal patch on the forewing at 1/2. In the genitalia, the strong setae arising from the dorsal surface of the valva, and the relatively small gnathos are also characteristic.

Derivation. – The species is named after Pelops, a character in Greek mythology. His father Tantalus cut him up and served his flesh to the gods to test them. The goddess Demeter ate part of Pelops' shoulder, but soon realized her mistake. Pelops was then reassembled and given a new shoulder made of ivory.

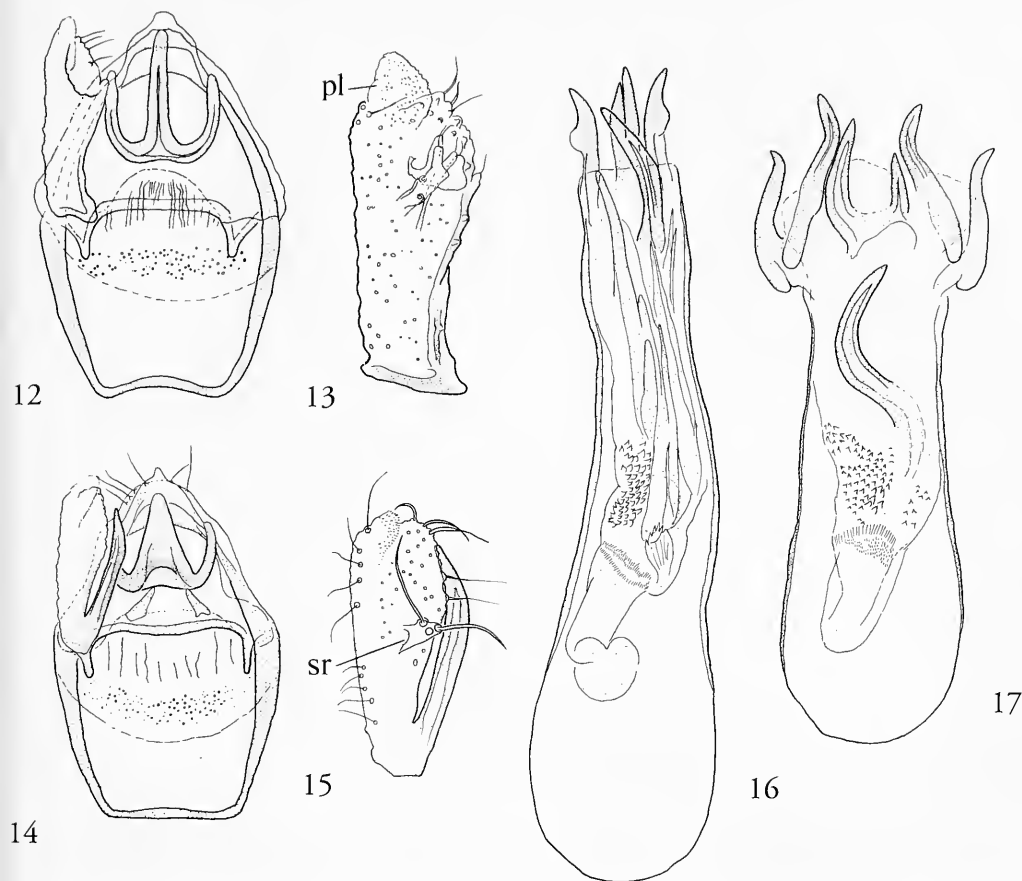
(Tantalus was suitably, and eternally, punished). The name was suggested by the conspicuous patch of raised white scales at the base of the moth's forewing.

Remarks. – Three female specimens collected in the same locality and on the same date as the males of *E. (F.) pelops* are present in ANIC. The genitalia show that they belong to *Ectoedemia*, so they are presumed on circumstantial evidence to be referable to the *van-nifera* group. They closely resemble the males of *E. (F.) pelops* apart from lacking the androconial scales on the wings and abdomen. Although no superficial differences have been observed between these specimens, the genitalia indicate that they belong to two species, i.e. presumably *E. (F.) pelops* and an undescribed species. The females are therefore excluded from the type series of *E. (F.) pelops*.

*Ectoedemia (Fomoria) squamibunda* sp. n.

Material examined. – Holotype, ♂, AUSTRALIA: Queensland, 27.34S 152.01E, Toowoomba, Redwood Park, emerged 22–23 Jan 1996, R. J. B. Hoare & I. F. B. Common. Genitalia slide 12095 (ANIC). – Paratypes, 2♂, 3♀, same data as holotype, emerged 4–27 Jan 1996; 1♂, Queensland, 27.34S 152.01E, 5 km E of Toowoomba, 340m, emerged 10 Nov 1985, I. F. B. Common; 1♂, 1♀, Queensland, Toowoomba, 30 Nov 1983, E. S. Nielsen. Slides 10176, 11259, 11298 (ANIC). 1♂, Queensland, 28.11S 153.11E, Lamington Nat. Pk, Binna Burra, 700m, 27 Nov 1989, I. F. B. Common. Slides 10197, 11272 (ANIC).

Male (fig. 33). – Wingspan 5.2–5.8 mm. Head capsule (fig. 2): labial palpi moderate, slightly longer than galeae; maxillary palpi with ratio of segments from base approximately 0.3: 0.3: 0.6: 1.3: 1; eyes very large, interocular index 1.15; scape (fig. 3) large, with scale-sockets grouped into 6 parallel rows; pedicel modified, with complex pocket-like invagination; flagellar segments with sensillum vesiculocladum unbranched and bordered by long microtrichia. Frontal tuft black; collar blackish; eyecaps whitish ochreous; antennae whitish ochreous, 45–48 segments. Thorax and tegulae whitish ochreous. Basal 1/2 of forewing with blackish scales overlain by whitish ochreous scales, giving grey appearance; base of costa, small basal spot just dorsad of fold, and small spot near wing apex black; a black, slightly outwardly oblique streak from costa just beyond 1/2 reaching 1/2 way across wing; rest of wing whitish ochreous with a few fuscous-tipped scales; cilia whitish ochreous. Hindwing translucent whitish; basal 1/2 overlain with elongate black androconial scales, extending into fringe on dorsum; these in turn overlain by a few whitish ochreous scales; cilia whitish ochreous. Underside: forewing with basal 1/2 silver-grey, blackish towards costa; a



Figs 12-17. *Ectoedemia (Fomoria)* spp., male genitalia. – 12, 13, 16, *E. (F.) squamibunda*: 12, genital capsule, ventral view; 13, right valva, dorsal view; 16, aedeagus, ventral view; 14, 15, 17, *E. (F.) hadronycha*: 14, genital capsule, ventral view; 15, right valva, dorsal view; 17, aedeagus, ventral view. pl = pin-cushion lobe; sr = setose ridge of valva.

broad band of blackish scales from costa at about  $\frac{1}{2}$  reaching  $\frac{1}{2}$  way across wing, rest of wing ochreous-fuscous; hindwing silver-grey with long black androconial scales at base of cilia in basal  $\frac{1}{2}$ . Wing venation as in fig. 4; typical of the subgenus. Abdomen: dorsum of basal segment overlain by black androconial scales; rest of abdomen shining pale grey.

Female (fig. 34). – Wingspan 5.8-6.2 mm. Similar to male, but eyecap smaller; antenna with 42 segments; forewing broader, whitish ochreous without underlying black scales, basal dot absent, but additional black dot on fold at  $\frac{1}{4}$  present. Hindwing and abdomen pale shining greyish without androconial scales. Underside: forewing ochreous fuscous, unmarked; hindwing pale grey.

Male genitalia (figs 12, 13, 16). – Genital capsule ca. 455  $\mu$ m long. Vinculum anteriorly squared off. Tegumen rounded, slightly produced posteriorly,

with 4 setae on each side. Uncus teat-shaped, reaching beyond tegumen. Gnathos enlarged, with long narrow central element. Valva (fig. 13) ca. 250  $\mu$ m long, squarish, inner (medial) margin nearly perpendicular; inner  $\frac{1}{2}$  of apex with 2-3 rows of small blunt projections, each bearing a seta; a row of 4-5 elongate papillae, each bearing a seta, projecting from just below apex of valva dorsally into genital capsule; pin-cushion lobe prominent, projecting beyond rest of valva. Aedeagus (fig. 16) ca. 590  $\mu$ m, narrow; a large ventral carina, apically with 2 points, one slightly longer than the other; 2 small lateral claw-like carinae. Vesica with central field of very long narrow cornuti; apex with a long, curved cornutus projecting between carinae.

Female genitalia (fig. 19). – Total length ca. 1080-1120  $\mu$ m. Abdomen bluntly rounded. T9 with ca. 15 setae on each side. Apophyses narrow, posteriores and

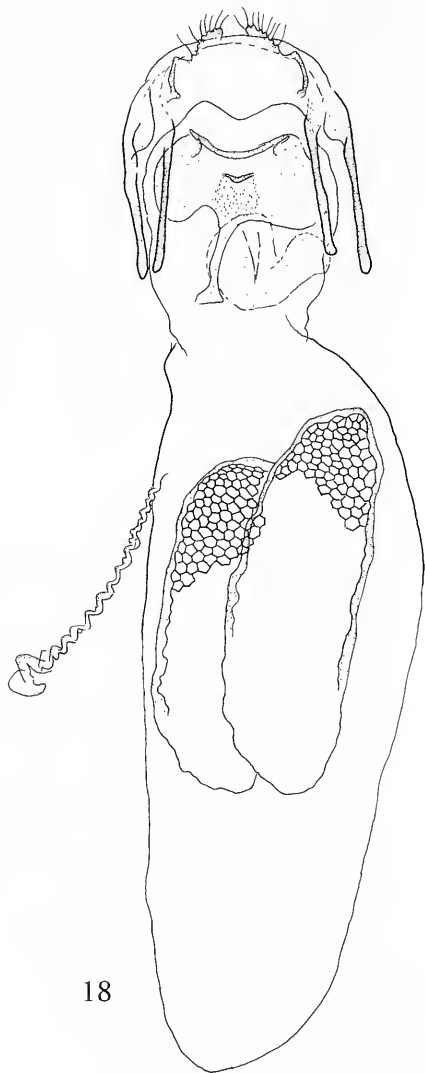
anteriores about equal in length. Vestibulum with complex sclerotizations. Ductus spermathecae with  $15\frac{1}{2}$  convolutions. Corpus bursae oblong; signa reticulata ca.  $415\text{--}430\text{ }\mu\text{m}$  long, borders of reticulations relatively broad.

Larva. – Yellowish. Head-capsule (figs 20–22) rather elongate; length ca.  $615\text{ }\mu\text{m}$ ; width ca.  $510\text{ }\mu\text{m}$ ; frontoclypeus (fig. 20) stirrup-shaped; anterior tentorial arms ca. 2 times as long as posterior. Thorax: mesothorax with 10 pairs of setae (4 setae ventral to SV1). Spines distributed as follows: meso- and metathorax and A1–5 with 2 small patches on anteri-

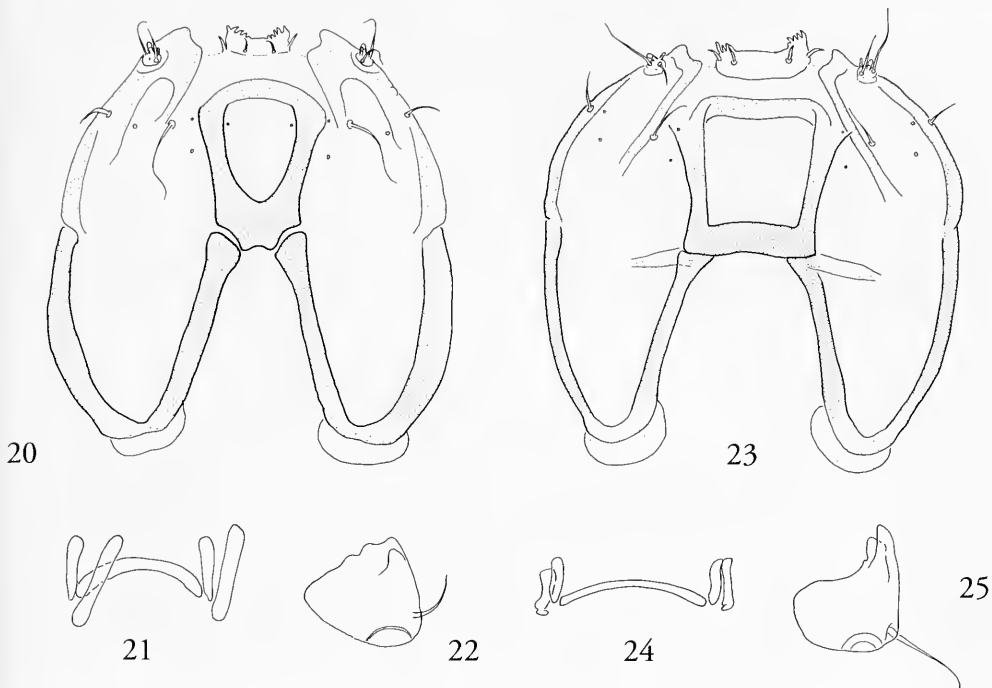
or margin of venter, each side of the mid-line; A6–9 with a single larger patch; A5–9 with an additional patch on anterior edge of dorsum, larger on A7–8.

Biology. – Host-plant: *Capparis arborea* (F. Muell.) Maiden (Brassicaceae). Egg: usually on the upper side of the leaf, near or adjacent to the midrib. Mine (fig. 29): a more or less contorted gallery with linear frass leaving very narrow clear margins; exit-hole on upper side of leaf. Cocoon: reddish brown. Occupied mines were collected on 17 July 1995.

Diagnosis. – Superficially similar to *E. (F.) hadronycha* sp. n.; the differences are listed under that species.



Figs 18, 19. *Ectoedemia (Fomoria)* spp., female genitalia (reticulations of signa only partly indicated). – 18, *E. (F.) hadronycha*; 19, *E. (F.) squamibunda*.



Figs 20-25. *Ectoedemia* (*Fomoria*) spp., larval heads (final instar). – 20-22, *E. (F.) squamibunda*: 20, head capsule, dorsal view; 21, tentorium; 22, right mandible; 23- 25, *E. (F.) hadronycha*: 23, head capsule, dorsal view; 24, tentorium; 25, right mandible.

**Derivation.** – The specific name means ‘very scaly’ and is derived from the Latin *squama* (a scale) and the suffix *-bundus* (denoting augmentation). It refers to the many black androconial scales at the base of the forewing and hindwing in the male, which give the moth a roughened appearance.

**Remarks.** – Specimens reared in a cool room in Canberra did not emerge until January; however as the three wild-caught specimens were all taken in November (and the male paratype reared in Toowoomba also emerged during this month), the latter is more likely to represent the normal time of flight.

***Ectoedemia (Fomoria) hadronycha* sp. n.**

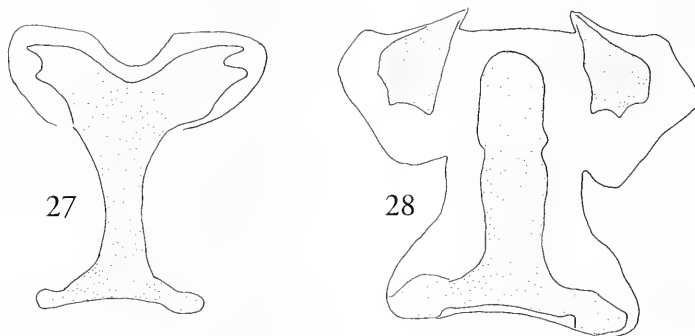
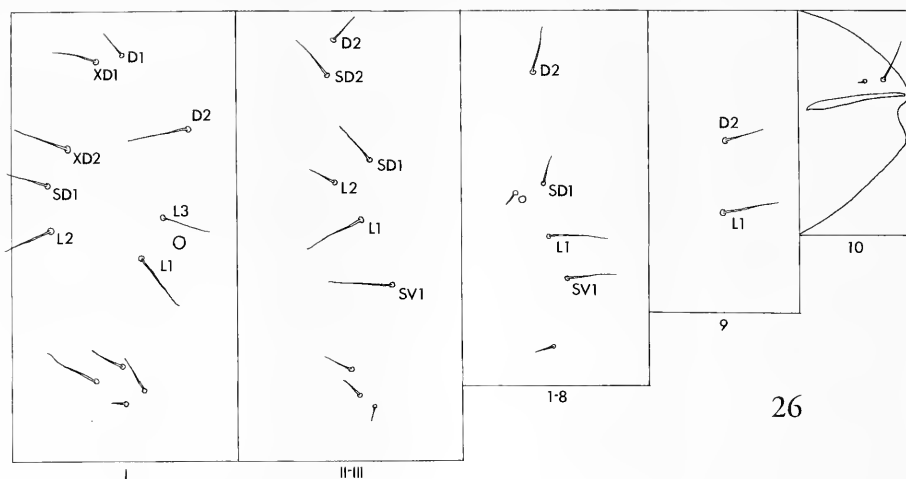
**Material examined.** – Holotype ♂, AUSTRALIA: Queensland, 26.57S, 151.52E, 6km NNE of Cooyar, emerged 29 Sep 1995, R. J. B. Hoare & I. F. B. Common. Genitalia slide 12094 (ANIC). – Paratypes, 3♂, 2♀, same data as holotype, emerged 22-29 Sep 1995. Genitalia slides 11268, 11319 (ANIC).

**Male (fig. 35).** – Wingspan 6.2-6.6 mm. Head: frontal tuft black; collar black; eyecaps whitish ochreous with a few fuscous-tipped scales; antennae dark

lead-grey, 51-53 segments. Thorax, tegulae and forewing whitish ochreous irrorated with fuscous; base of costa blackish; a tuft of raised elongate whitish ochreous to fuscous scales just below costa near base; a blackish streak from costa just beyond  $\frac{1}{2}$  reaching  $\frac{1}{2}$  way across wing; a blackish dot near apex; cilia at apex concolorous with forewing, shining yellowish grey on tornus and dorsum. Hindwing pale grey; cilia shining yellowish grey. Underside: forewing fuscous, darker towards costa; hindwing pale grey. Abdomen shining grey.

**Female (fig. 36).** – Wingspan 6.5-7.1 mm. Similar to male, but antenna with 42 segments; eyecaps without fuscous-tipped scales; forewing broader, more yellowish, with sparser irrorations and no subcostal patch of raised scales.

**Male genitalia (figs 14, 15, 17).** – Genital capsule ca. 410-425  $\mu$ m long. Vinculum with anterior extension relatively long, squared off. Tegumen rounded, with ca. 4-5 setae on each side. Uncus teat-shaped, reaching beyond tegumen. Gnathos enlarged, with broad triangular central element. Valva (fig. 15) ca. 190-215  $\mu$ m, deeply cleft from near base; inner (medial) part consisting of a narrow, strongly sclerotized, curved spine,  $\frac{4}{5}$  length of valva; main (exterior) part rounded, with



Figs 26-28. *Ectoedemia (Fomoria)* spp., larval cuticle. – 26, *E. (F.) hadronycha*, chaetotaxy; 27, *E. (F.) squamibunda*, prothoracic sternite; 28, *E. (F.) hadronycha*, prothoracic sternite.

moderately large pin-cushion lobe and a complex setose process arising on dorsal surface and projecting into genital capsule. Aedeagus (fig. 17) ca. 465  $\mu\text{m}$  long, broad, fused to posterior membranous part of vinculum by 2 very small sclerotized tooth-like processes; 2 pairs of curved lateral carinae, one pair situated dorsally, one pair ventrally; 2 central, ventral carinae. Vesica with one very large curved cornutus, and a field of small, leaf-like cornuti near base of ejaculatory duct.

Female genitalia (fig. 18). — Total length ca. 1170  $\mu$ m. T9 with ca. 14 setae on each side. Apophyses narrow, anteriores slightly longer than posteriores. Vestibulum with large ventral dumbbell-shaped sclerotization, produced antero-dorsally into a narrow process; a second irregular sclerite to the right of this process in dorsal view. Ductus spermathecae with 11½ convolutions. Corpus bursae oblong; signa reticulata broad, ca. 440  $\mu$ m long, borders of reticulations

narrow.

Larva. – Yellowish, gut green. Head capsule (figs 23–25) rather broad; length ca. 600 µm; width ca. 520 µm; frontoclypeus (fig. 23) squarish, only slightly narrowed posteriorly; anterior and posterior tentorial arms short and roughly equal in length. Thorax: chaetotaxy as in fig. 26; mesothorax with 9 pairs of setae (3 setae ventral to SV1). Spinosity: ventral spines as described for *E. (F.) squamibunda*; dorsal spines absent.

Biology. — Host-plant: *Capparis arborea* (Brassicaceae). Egg: on leaf upperside. Mine (fig. 30): similar to that of *E. (F.) squamibunda*, but distinctly broader in its later stages. Cocoon: reddish brown. Occupied mines were collected on 18 July 1995.

**Diagnosis.** — Both male and female are larger than those of *E. (F.) squamibunda*. The male of *E. (F.) hadronycha* lacks the black androconial scales on forewing and hindwing, and the female has the



Figs 29-32. *Ectoedemia* (*Fomoria*) spp., larval mines and adults. — 29, *E. (F.) squamibunda* sp. n., larval mine on *Capparis arborea*; 30, *E. (F.) hadronycha* sp. n., larval mine on *Capparis arborea*; 31, *E. (F.) glycystrata*, ♂ lectotype; 32, *E. (F.) pelops* sp. n., ♂ holotype.

forewing more extensively irrorated with fuscous than that of *E. (F.) squamibunda*, and lacks the conspicuous black dot on the fold. In the male genitalia, the broad gnathos, the large valval spine and the broad aedeagus of *E. (F.) hadronycha* distinguish it from *E. (F.) squamibunda*. In the female genitalia, *E. (F.) hadronycha* is distinguished by the narrow borders to the reticulations of the signa, and by the smaller number of convolutions in the ductus spermathecae.

**Derivation.** — The specific name is derived from the Greek *hadros* (stout or thick) and *onyx* (a claw), and refers to the large spine-like process on the medial edge of the valva.

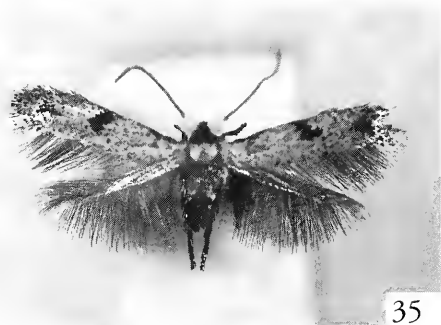
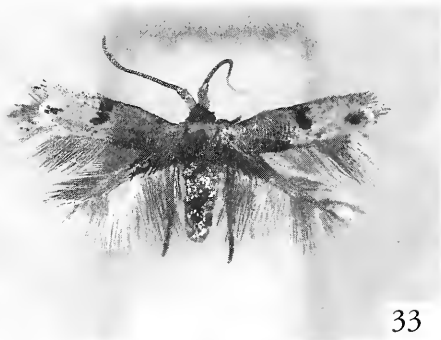
**Remarks.** — This species has only been collected from a single tree in a narrow belt of dry rainforest along a roadside. Much of the original vegetation in the area has been cleared; therefore it is possible that the species is under threat.

#### PHYLOGENETIC ANALYSIS

##### Choice of terminal taxa

All named (including newly described) species known to have the pin-cushion lobe of the valva in the male genitalia were included as ingroup taxa in the analysis. Apart from the *Ectoedemia* (*Fomoria*)

*vannifera* group, the *E. (F.) weaveri* group is the only other recognized species group within *Fomoria* (see van Nieuwerkerken 1986). The monophyly of the *E. (F.) weaveri* group has been asserted by van Nieuwerkerken (1986) and by Johansson et al. (1990), but these authors did not list any defining apomorphies. I believe that the monophyly of the *weaveri* group is confirmed by the following apomorphies shared by all species: lateral arms of gnathos straight, more or less horizontal; lateral arms of vinculum strongly expanded medially and meeting anterior to gnathos. The following may represent apomorphies of the *weaveri* group as a whole, but are not shared by all species: host-plant *Hypericum* (Clusiaceae); pupation inside mine; valva with sharp dorsal spine (this spine differs in position and shape from the blunt spine on the medial edge of the valva in some species of the *E. (F.) vannifera* group (see below), although it may be homologous). On this basis, I regard the following described species as belonging to the *weaveri* group (cf. van Nieuwerkerken 1986): *E. (F.) septembrella* (Stainton), Palaearctic; *E. (F.) weaveri* (Stainton), Palaearctic; *E. (F.) luisae* (Klimesch), Turkey; *E. (F.) deschkai* (Klimesch), Greece; *E. (F.) variicapitella* (Chrétien), Morocco, Canary Islands; *E. (F.) hypericifoliella* (Kuroko), Asia; *E. (F.) permira* (Pupplesis),



Figs 33-36. *Ectoedemia (Fomoria)* spp., adults. – 33, 34, *E. (F.) squamibunda* sp. n.: 33, ♂ holotype, 34, ♀ paratype; 35, 36, *E. (F.) hadronycha* sp. n., paratypes: 35, ♂, 36, ♀.

Asia; *E. (F.) hypericella* (Braun), North America; *E. (F.) pteliacella* (Chambers), North America.

The *E. (F.) weaveri* group is considered to be closely related to the *E. (F.) vannifera* group. In a cladistic analysis of the Nepticulidae (Hoare unpublished) based on 23 ingroup taxa (including one member of each of these groups) and 56 characters, a sister-group relationship between the two groups was recovered on the basis of the following apomorphies in the male genitalia: valvae widely separated at base; vinculum produced posteriorly into a membranous juxta-like lobe between the valvae. These apomorphies are shared by all members of both groups. The species of the *E. (F.) weaveri* group are mostly very similar in morphology, and it would make little difference which species was chosen as an outgroup exemplar for the phylogenetic analysis of the *vannifera* group. Because of availability of material, *E. (F.) septembrella* was used as the outgroup taxon in the current analysis.

### Characters

The three multi-state characters were treated as unordered.

1. Colour of head-tuft: (0) orange; (1) whitish to ochreous (may be mixed with fuscous scales); (2) black.

2. Ground colour of forewing: (0) greyish; (1) ochreous.
3. Forewing – black streak from costa at ½: (0) absent; (1) present.
4. Knob of raised scales at base of male forewing: (0) absent; (1) present.
5. Underside of male forewing: (0) without specialized scales; (1) with black androconial scales; (2) with white androconial scales.
6. Underside of male forewing – hair pencil: (0) absent; (1) present.
7. Base of male hindwing: (0) normal; (1) expanded (Scole 1983: fig. 49).

Table 1. Data matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>E. septembrella</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>E. vannifera</i>	1	1	0	0	1	1	1	0	0	1	1	1	0	1	
<i>E. fuscata</i>	1	1	0	0	0	0	0	0	0	1	1	1	0	0	
<i>E. bobohmi</i>	1	1	0	0	0	0	0	0	1	1	1	1	0	1	
<i>E. glycystrata</i>	1	1	0	0	2	0	0	0	0	1	1	1	0	1	
<i>E. asiatica</i>	1	1	0	0	1	1	1	0	0	1	1	1	0	1	
<i>E. pelops</i>	2	1	0	1	0	0	0	2	1	0	1	0	1	1	0
<i>E. squamibunda</i>	2	1	1	0	0	0	0	2	0	1	1	0	1	1	0
<i>E. hadronycha</i>	2	1	1	1	0	0	0	0	1	1	1	1	1	1	0

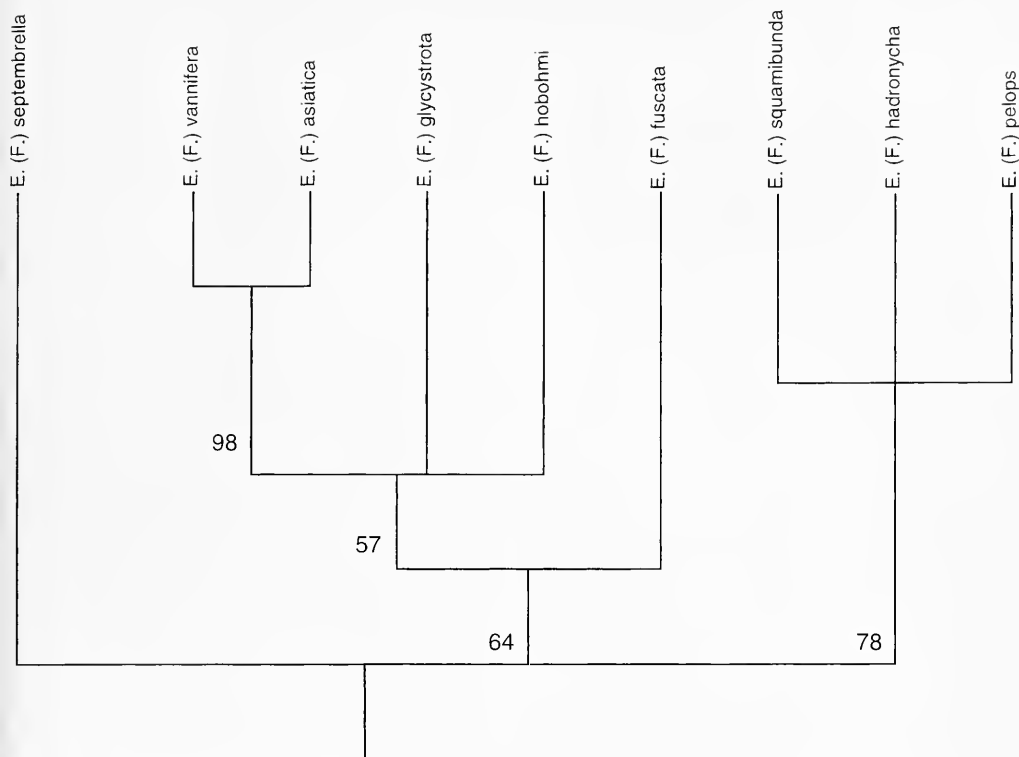


Fig. 37. Strict consensus tree of 4 equally most parsimonious trees from data set of *Ectoedemia (Fomoria) vannifera* group, with bootstrap support for clades (1000 bootstrap replicates, branch and bound search).

8. Base of male hindwing: (0) without specialized scales; (1) with a patch of black scales in anterior half; (2) with black scales across whole depth of wing.
9. Male genitalia – posterior extension of vinculum: (0) without sclerotized juxta-like processes; (1) with paired sclerotized processes (figs 8, 14).
10. Male genitalia – gnathos: (0) normal; (1) enlarged (figs 12, 14).
11. Male genitalia – pin-cushion lobe of valva: (0) absent; (1) present (figs 6, 9, 13, 15).
12. Male genitalia – mesal spine of valva: (0) absent; (1) present (fig. 15).
13. Male genitalia – ridge or projection on dorsal surface of valva: (0) absent; (1) present (figs 6, 9, 13, 15). The form of this ridge varies considerably between species; it usually bears more or less conspicuous setae.
14. Male genitalia – shape of uncus: (0) inverted V or Y, shorter than tegumen (fig. 5; Scoble 1983: fig. 100); (1) nipple-like, reaching beyond tegumen (figs 8, 12, 14).
15. Male genitalia – aedeagus: (0) with 1 field of

cornuti (figs 11, 16, 17); (1) with 2 parallel fields (fig. 7).

The data matrix is presented in table 1.

## Results

An exhaustive search in PAUP 3.1.1 resulted in 4 most parsimonious trees (length 23; C.I. = 0.83, R.I. = 0.83), differing only in the position of *E. (F.) hobohmi* with respect to *E. (F.) glycystrata* and the clade formed by *E. (F.) vannifera* + *E. (F.) asiatica*, and in the inter-relationships of the three Australian species. A strict consensus tree is presented in fig. 37, together with bootstrap support for the nodes recovered (1000 bootstrap replicates, branch and bound search). The species-group falls into two monophyletic sub-groups: one comprising the Australian species, and one comprising all the remaining species from South Africa, India and central Asia. The biogeographical implications are discussed below.

The apomorphies for groups that are constant in all most parsimonious trees are listed here; the character number followed by state are given in parentheses. As

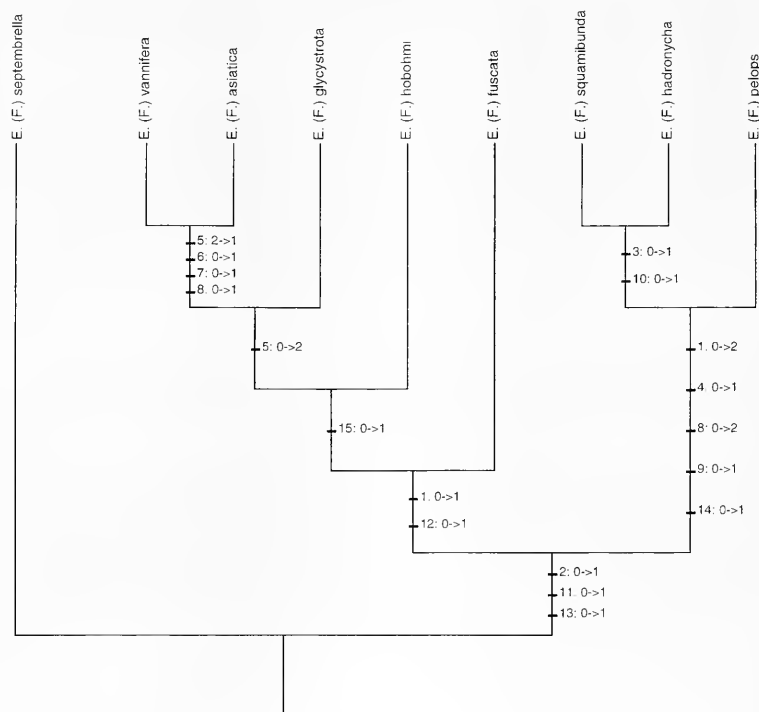


Fig. 38. Preferred fully resolved estimate of phylogeny of *E. (F.) vannifera* group, with apomorphies of clades.

only a single outgroup was used, the monophyly of the *E. (F.) vannifera* group was not strictly tested in the current analysis. However, its monophyly is strongly supported by the following three apomorphies (there is little doubt about the polarity of the characters concerned): male valva with pin-cushion lobe (11-1; present in all species, and unique to the group); male valva with dorsal projection or sclerotized ridge (usually setose) (13-1; present in all species and unique to the group); forewing ground colour ochreous (2-1; most species of *Ectoedemia*, including all described species in the *E. (F.) weaveri* group, have the forewing ground colour greyish fuscous to black).

The monophyly of the group containing all the South African and both the Asian species is supported by the following two apomorphies: head colour whitish to ochreous, more or less mixed with fuscous scales (1-1; in most species of *Ectoedemia*, including members of the *E. (F.) weaveri* group, the frontal tuft of the head is orange); valva with spine on medial edge (12-1; in these species the spine is short and blunt, and it is most parsimonious to assume that the very large spine on the valva of the Australian *E. (F.) hadronycha* has evolved independently; otherwise, the spine has been lost independently by *E. (F.) squami-*

*bunda* and *E. (F.) pelops*).

The monophyly of the group comprising the Australian species is supported by seven apomorphies. Two are unambiguous, viz.: head colour black (1-2); uncus nipple-like (14-1; in the other members of the *vannifera* group and in the members of the *weaveri* group, the uncus is in the form of an inverted V or Y). The following five apomorphies are present in only two of the three species: forewing with a black streak from the costa at  $\frac{1}{2}$  (3-1; absent from *E. (F.) pelops*); base of male forewing with a knob of raised scales (4-1; absent from *E. (F.) squamibunda*); base of male hindwing with black androconial scales from costa to dorsum (8-2; absent from *E. (F.) hadronycha*); membranous posterior extension of vinculum with a pair of sclerotized juxta-like processes (9-1; absent from *E. (F.) squamibunda*); gnathos enlarged (10-1; paralleled in *E. (F.) hobohmi*; the gnathos is normal in *E. (F.) pelops*). I assume that a gain of a structure followed by a loss is a more parsimonious explanation of the data than two independent gains. Then, if *E. (F.) hadronycha* and *E. (F.) pelops* are sister-species, character states 3-1, 8-2 and 10-1 are apomorphies of the entire clade of three species. If, however, *E. (F.) squamibunda* and

*E. (F.) hadronycha* are considered sister-species, it is most parsimonious to assume that character states 4-1, 8-2 and 9-1 are apomorphies of the Australian clade as a whole. I tentatively prefer this latter hypothesis, as these two species share the same host-plant (*Capparis arborea*) (host-plant data are missing for most species in the analysis, so this was not coded as a character).

Within the African / Asian clade, *E. (F.) fuscata* is sister to the remaining species, which all share the following apomorphy: aedeagus with two parallel fields of cornuti (15-1). The sister-species relationship between *E. (F.) asiatica* and *E. (F.) vannifera* is supported by the following four apomorphies: male forewing underside with a patch of black androconial scales (5-1); male forewing underside with a hair-pencil (6-1); base of male hindwing expanded (7-1); base of male hindwing with black androconial scales in anterior half (8-1).

It is very probable that the white androconial scales on the underside of the male forewing in *E. (F.) glycystrata* are homologous with the black scales in *E. (F.) asiatica* and *E. (F.) vannifera*, and have not been developed independently. I therefore suggest that *glycystrata* is sister-species to *asiatica* + *vannifera*.

The preferred fully resolved phylogenetic hypothesis is presented in fig. 38.

## DISCUSSION

Some caution is needed in interpreting the results of the cladistic analysis presented here. Most of the characters used are derived from the males, and a number of them are secondary sexual characters such as presence or absence of androconial scales and associated modifications. As such structures are presumably subject to strong sexual selection, and hence are liable to evolve quickly, they may be expected to show a relatively high level of homoplasy. Moreover, separate structures associated with the dispersal of pheromones may not always evolve independently; i.e. it may be incorrect to treat them as independent characters for the purpose of cladistic analysis. For example, in *Trifurcula* Zeller, the tufts of hair-scales on T6-7 of the male abdomen, together with the patch of raised scales on the underside of the hindwing and the third branch of Rs+M in the hindwing are probably a complex scent-dispersal structure, rather than three independent characters (cf. Johansson et al. 1990: 260). The same may be true of the androconial structures of *Ectoedemia (Fomoria) vannifera* and *E. (F.) asiatica*. However, other species in the group show some of the same androconial structures, but not all: for example, a male paralectotype of *E. (F.) hobohmi* (which probably represents an undescribed species) has a hair-pencil on the underside of the forewing similar to that found in *E. (F.) vannifera*, but lacks the black specialized scales of the latter species

(Scoble 1983: 38). There is therefore some justification for treating the characters as independent.

## The monophyly of the subgenus *Fomoria*

*Fomoria* was named by Beirne (1945) after a race of demonic and malevolent beings who ruled Ireland in the mythical past (Emmet 1991). This is perhaps appropriate from a systematist's point of view, given that it remains the only subgenus in the Nepticulidae for whose monophyly no evidence has been found. However, some monophyletic groups can be recognized within the subgenus; these are discussed below.

The monophyly of the *E. (F.) vannifera* group has been argued for above. The monophyly of the *E. (F.) weaveri* group has also been argued for here (see above, under Phylogenetic analysis). In addition to the material of the *E. (F.) vannifera* group, there is a single male *Ectoedemia* specimen in ANIC from Lamington National Park, Queensland, collected on 14 Nov 1990. It differs strikingly from most members of the genus, and indeed most nepticulids, in the predominantly silver coloration of its forewings. However, it shares both the apomorphies (lateral arms of gnathos horizontal; lateral arms of vinculum expanded) here used to define the *E. (F.) weaveri* group. It also shares the possible apomorphy: valva with sharp dorsal spine. This represents the first record of the *weaveri* group from the southern hemisphere, and has potentially interesting implications for the origin and age of the group. Unfortunately, the males of the *weaveri* group show less morphological variation than those of the *vannifera* group. Therefore, until more material of the Australian species becomes available, including females and larvae, it is probably premature to speculate on the phylogeny and biogeography of the group.

I tentatively propose here that a third species-group can be recognized within *Fomoria*. This group includes at least three species: *E. (F.) groschkei* (Skala) from southern Europe, *E. (F.) thermae* Scoble from South Africa, and an undescribed species from Japan (van Nieukerken 1986). I have not examined these species in detail, and am unable to suggest any morphological apomorphies defining this group, but all three species share an unusual choice of host-plant family, the Verbenaceae: *E. (F.) groschkei* and *E. (F.) thermae* have larvae mining in *Vitex* L. spp., and the undescribed species mines in *Callicarpa* L. The recently described *E. (F.) aegaiea* Z. & A. Laštuvka from Greece and Crete is also suspected to feed on *Vitex* (Laštuvka & Laštuvka 1998), and so possibly also belongs here. The group is referred to below as the *groschkei* group.

The synapomorphies given above to link the *vannifera* and *weaveri* groups (valvae widely separated at base; vinculum with posterior extension) may be evidence of the monophyly of a subsection of *Fomoria* comprising the *weaveri* group, the *vannifera* group

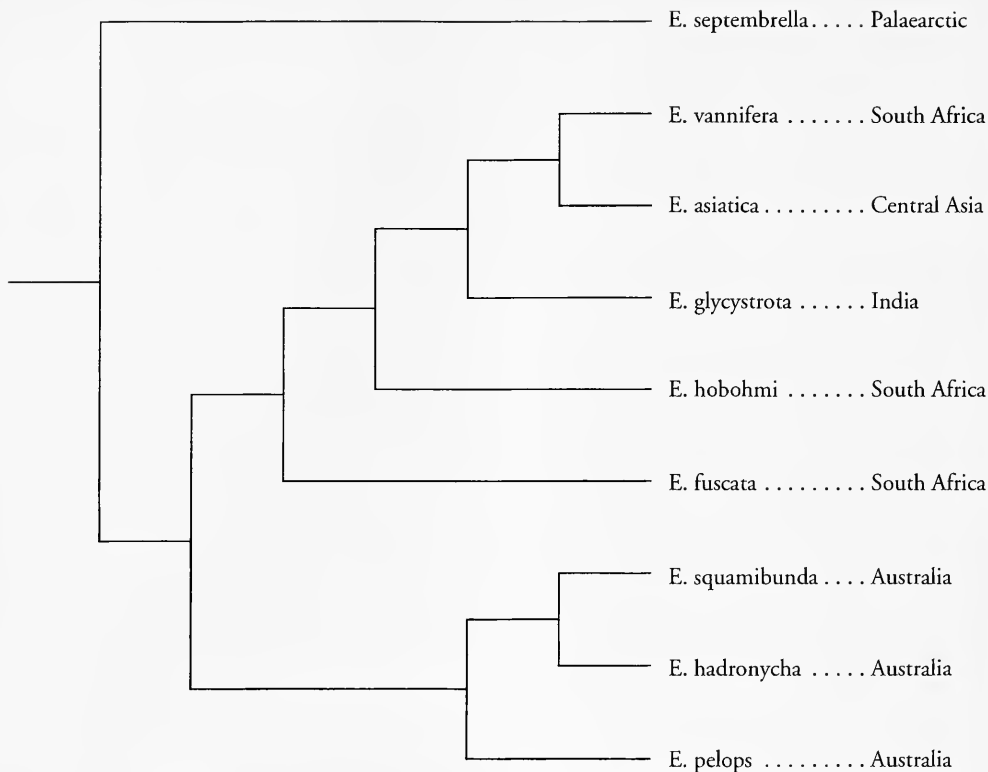


Fig. 39. Phylogeny of *E. (F.) vannifera* group, with geographical origin of each species.

and the *groschkei* group. However, the degree of separation of the valvae at their bases is a rather variable character, and perhaps should not be accorded too much weight: widely separate valvae are also found elsewhere in *Ectoedemia*, for example in *E. (Laqueus) crispae* Scoble. Even if one accepts the monophyly of this 'core group' within *Fomoria*, there remains a substantial residue, comprising at least 12 described species from South Africa, *E. (F.) flavimacula* (Puplesis & Diškus) and *E. (F.) lacrimulae* (Puplesis & Diškus) from Central Asia and the European *E. (F.) viridissimella* (Caradja).

Some preliminary studies of larval morphology indicate a possible sister-group relationship between the subgenera *Fomoria* and *Laqueus* (Hoare unpublished). The two most convincing synapomorphies supporting this relationship are: loss of seta D1 on larval mesothorax, and loss of one SD seta on larval prothorax. It would be interesting to see whether these synapomorphies applied to the many South African species of *Laqueus* and *Fomoria* whose larvae have not been examined. The monophyly of *Laqueus* is not in serious doubt: all species have veins 1A and 2A separate at the base of the forewing, forming a so-called 'anal loop'

(Scoble 1983; van Nieukerken 1986). The European species at least also have a bisetose larval stipes (van Nieukerken 1986) (a character state not otherwise found in the Nepticulinae, although at least some pectinivalvine larvae have a bisetose stipes (Hoare in press)). However, the possibility cannot be ruled out that *Laqueus* was derived from within *Fomoria*: if so, the latter subgenus is paraphyletic as it stands, and *Laqueus* should be synonymized with *Fomoria*. It is obviously premature to make this synonymy at this stage, but it is perhaps increasingly unlikely that any apomorphic features unique to *Fomoria* and not shared by *Laqueus* will be found.

#### Host-plant relationships and biogeography of the *Ectoedemia (Fomoria) vannifera* group

The preferred phylogeny of the *E. (F.) vannifera* group from the current analysis is reproduced in fig. 39, annotated with the region in which each species occurs. The nesting of *E. (F.) glycystrota* (Meyrick) from India and *E. (F.) asiatica* (Puplesis) from central Asia within the clade formed by the South African species, together with the strongly supported sister-species relationship between *E. (F.) asiatica* and *E.*

(*F.*) *vannifera*, indicate a complex biogeography for the group. Clearly, the group has dispersed widely at some stage in its history: the question is whether this dispersal preceded the break-up of the continents in the Mesozoic, in which case the group is very old, or whether it has spread more recently.

India, Australia and South Africa are well known to have been joined as part of the southern supercontinent Gondwana until the early Cretaceous (e.g. Scotese et al. 1988). If the *vannifera* group originated before Gondwana began to fragment, it is possible that its current distribution is a reflection of that continental break-up. If so, the group perhaps shows a 'northern Gondwanan' distribution of the type described by Edmunds (1975) for leptophlebiid mayflies, and by Cranston & Hare (1995) for *Conochironomus* Freeman (Diptera: Chironomidae), although the presence of a species in central Asia, not usually considered a part of Gondwana, remains anomalous. The paraphyly of the South African species with respect to those from India and central Asia could then indicate that speciation within the *vannifera* group had already begun before Africa and India separated ca. 130–120 million years B.P. However, one should probably not make too much of the relationships within the major clades in arguing about biogeography, given the relatively limited nature of the data set. If vicariance is the true explanation for the current distribution of the group, further field-work should reveal its presence in Madagascar, which was contiguous with both India and southern Africa in Gondwanan times.

Unfortunately, the host-plant relationships of the *vannifera* group are not conclusive in deciding whether its apparently disjunct distribution is indeed a result of vicariance. Only three species of the group have been reared: *E. (F.) squamibunda* and *E. (F.) hadronycha* from Australia both feed on *Capparis arborea*, and the South African *E. (F.) vannifera* feeds on *Boscia oleoides* (Burch. ex DC.) Tölken (Scoble 1983: 38). *Capparis* L. and *Boscia* Lam. are closely related genera which have long been included in the Capparaceae, but there is now strong evidence that this family is paraphyletic with respect to Brassicaceae (Judd et al. 1994), and the latter family has been expanded to include it (Angiosperm Phylogeny Group 1998). As *E. (F.) squamibunda* and *E. (F.) hadronycha* are relatively distant from *E. (F.) vannifera* in the phylogeny, it seems fair to assume that all species in the group will be found to feed on *Capparis* or related brassicaceous plants. The genus *Capparis* itself is worldwide in the tropics and in warm temperate regions, occurring both in rainforest and in semi-arid or arid habitats, and does not share the apparently disjunct distribution of the *vannifera* group. 'Capparaceae' have never been considered to be an ancient Gondwanan group of plants, although it

should be noted that little biogeographic work has been done on the group. It seems possible that relatively recent dispersal has played at least some part in the current distribution of these plants, and that *Capparis* may not have reached Australia until the late Tertiary. As Nepticulidae are unlikely to be able to disperse effectively over very long distances, their ranges should track contiguous parts of their host-plants' ranges fairly closely. It is important to note that very few Nepticulidae have been sampled from large areas of tropical Africa and Asia. Thus, if a hypothesis of relatively recent dispersal is correct, further collecting should reveal new species of the *vannifera* group in other areas where the host-plants occur, for example northern Africa, the Middle East and South-East Asia. A very different picture of the distribution and phylogenetic relationships of the group may then emerge.

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## APPENDIX

### Material examined for cladistic analysis

Material examined of the three Australian species and of *Ectoedemia* (*Fomoria*) *glycystrota* is listed in the main text.

#### *Ectoedemia* (*Fomoria*) *septembrella* (Stainton)

2♂, UK: Hants, Winchester, emg. Apr 1990, R.J.B. Hoare (ANIC slide 11269), ex larvae / pupae in leaves of *Hypericum* sp., Dec 1989 (ANIC, NZAC).

Larvae: Beekhuizen, NETHERLANDS, 24 Jun 1979, E.J. van Nieukerken, mining leaves of *Hypericum maculatum* (VU no. 79065; RMNH).

*E. (F.) asiatica* (Puplesis)

Paratype ♂, TADZHIKISTAN: 30 km N of Dushanbe, 21 Aug 1986, R.K. Puplesis (VU slide 2911; RMNH).

*E. (F.) vannifera* (Meyrick)

1♂, SOUTH AFRICA: Worcester, Fairy Glen, 15 or 19 Oct 1966, L. Vári, J.H. Potgieter (TM).

External characters of the following two species were scored from Janse (1948) and Scoble (1983): I have only personally examined the genitalia slides cited.

*E. (F.) fuscata* (Janse)

Lectotype ♂, NAMIBIA: Abachaub, Oct 1945, G. Hobohm (slide 4971; TM).

*E. (F.) hobohmi* (Janse)

Paralectotype ♂, NAMIBIA: Abachaub, Sep 1944, G. Hobohm (slide 10251; TM).

## NEW OR LITTLE KNOWN DERAEOCORINE PLANT BUGS FROM JAPAN (HETEROPTERA: MIRIDAE)

Nakatani, Y., T. Yasunaga & M. Takai, 2000. New or little known deraeocorine plant bugs from Japan (Heteroptera: Miridae). – Tijdschrift voor Entomologie 142 [1999]: 317-326, figs. 1-27. [ISSN 0040-7496]. Published 11 April 2000.

Five Japanese species in three genera of deraeocorine plant bugs are treated. *Apoderaeocoris* gen. n. is proposed to accommodate *A. decolatus* sp. n.. The genus *Fingulus* Distant is revised, with description of *F. takahashii* sp. n., and a key is provided to distinguish the three Japanese members. The genus *Cimidaecorus* Hsiao & Ren is reported from Japan for the first time, with the new species *C. hasegawai* sp. n.

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Key words. – Heteroptera; Miridae; Deraeocorinae; new genus; new species.

The plant bug subfamily Deraeocorinae predominantly consists of predaceous species. In Japan, 28 species in eight genera have hitherto been recognized within the subfamily (Miyamoto 1988, etc.). However, the Japanese fauna of this subfamily has been documented fragmentally, and is still in need of further investigation.

In this paper, five new or little known species in three genera are reported from Japan, including a new genus and three new species. A key is provided to distinguish the three Japanese species of *Fingulus*.

All measurements are given in millimeters. The material examined is deposited in the following institutes or collections: Biological Laboratory, Hokkaido University of Education, Sapporo (HUES); National Institute of Agro-Environmental Sciences, Tsukuba (NIAES); Natural History Museum and Institute, Chiba, A. Saitoh (CBM); Department of Zoology, National Science Museum, Tokyo, M. Tomokuni (NSMT); Miyamoto, personal collection, 3-34-4, Ikuura, Sawara, Fukuoka, S. Miyamoto (MC).

### *Fingulus* Distant

*Fingulus* Distant, 1904: 275, type species: *Fingulus atrocaeruleus* Distant, 1904, original designation; Carvalho 1952: 53; 1957: 86; Stonedahl & Cassis 1991: 5; Schuh 1995: 626; Kerzhner & Josifov 1999: 49.

*Ix* Bergroth, 1916: 234 (syn. by Carvalho 1955: 221).

*Anchix* Hsiao, 1944: 377 (syn. by Carvalho 1955: 221).

### Diagnosis

Recognized by the porrect head with the well-developed postocular region separated from vertex by a transverse furrow, and broad flattened pronotal collar. Right paramere of the male genitalia is noticeably small. Although the representatives of this genus exhibit unique features within the Miridae, they also possess many plesiomorphic genitalic characters.

The unique head structure might be correlated to its feeding habit. Stonedahl & Cassis (1991) suspected that most species of the genus are generalized predators with little or no host plant specificity. The last instar nymph, that apparently exhibits thrips-mimicry, possesses an elongate abdominal segment IX.

### Key to the Japanese species of *Fingulus* Distant

1. Head paler than remainder of body; tylus and frons small but sharply prominent; pronotal collar impunctate; corium with a pale spot posteriorly .....*collaris*  
– Dorsum uniform in coloration; tylus and frons widely and strongly prominent; pronotal collar punctate; corium without pale spot .....2
2. Dorsum brackish brown; each femur and basal tibia dark brown .....*longicornis*

- Dorsum reddish brown; legs entirely pale yellow  
.....*takahashii*

***Fingulus longicornis* Miyamoto**  
(figs. 1, 6, 9)

*Fingulus longicornis* Miyamoto, 1965: 154, ♂ (Okinawa Is., Ryukyus); Miyamoto & Yasunaga 1989: 158; Stonedahl & Cassis 1991: 30; Schuh 1995: 627; Kerzhner & Josifov 1999: 49.

**Diagnosis**

Recognized by the uniformly blackish brown body, contrastingly creamy white antennal segment II, distinctly punctate pronotal collar, and shining and hyaline membrane. A detailed description and redescription were provided by Miyamoto (1965) and Stonedahl & Cassis (1991), respectively.

Dimensions. – ♂/♀: Body length 3.61–4.13/ 4.11–

4.55; head width 0.65–0.66/ 0.64–0.69; length of antennal segment I 0.48–0.49/ 0.49–0.55, II 1.42–1.55/ 1.37–1.49, III 0.91–1.00/ 0.94–0.95, IV 0.56–0.59/ 0.50–0.58; basal pronotal width 1.38–1.49/ 1.44–1.67; maximum width across hemelytra 1.48–1.67/ 1.64–1.96; length of hind femur 1.26–1.31/ 1.27–1.59, tibia 1.72–1.76/ 1.77–1.96, tarsus 0.33–0.34/ 0.36.

**Distribution**

Japan (Shikoku, Kyushu, Ryukyu Islands), Taiwan, Philippines.

**Biology**

This is the most common species among its Japanese congeners, but the population density is rather low. In Okinawa Island of the Ryukyus, this mirid was found associated with *Gynaikothrips ficorum* (Marchal) (Thysanoptera, Phlaeothripidae) on *Ficus microcarpa* Linnaeus (Moraceae).



1



2



3



4

Figs. 1–4. *Fingulus* spp., adult (3 last instar nymph) – 1, *F. longicornis*; 2, *F. collaris*; 4, *F. takahashii*.

Material examined. — JAPAN: Shikoku: 1 ♀, Mt. Komenono, Ehime Pref., 13. vii. 1973, M. Sakai (NSMT); 1 ♂, Befu, Monobe V., Kochi Pref., 15. vii. 1995, M. Takai (NIAES). — Kyushu: 1 ♂, Shiramizu, Shonai T., Oita Pref., 27–28. vii. 1995, light trap, Y. Nakatani (NIAES); 1 ♀, Mt. Konpira Nagasaki Pref., 15. vii. 1973, S. Kinoshita (NSMT); 1 ♂, 1 ♀, Azuma T., 200 m alt., Nagasaki Pref., 29. viii. 1992, light trap, T. Yasunaga (HUES); 1 ♂, Konoura, Sotone T., Nagasaki Pref., on *Chamaecyparis obtusa*, same collector. — Ryukyus: 1 ♀, Yona, Kunigami V., Okinawa Is., 7. v. 1975, Y. Notsu (NSMT); 1 ♂, same locality, 20. v. 1993, Y. Nakatani (NIAES); 1 ♀, Nakagusuku C., Okinawa Is., 7. v. 1972, T. Teruya (NIAES); 1 ♀, Naha C., Okinawa Is., 27. v. 1975, Y. Notsu (NSMT); 1 ♀, same locality, 19. v. 1993, Y. Nakatani (NIAES); 6 ♂, 4 ♀, same locality, 1. v. 1997, S. Gotoh (NIAES).

***Fingulus collaris* Miyamoto**  
(figs. 2-3, 7, 10)

*Fingulus collaris* Miyamoto, 1965: 155, ♀ (Iriomote Is. Ryukyus); Miyamoto & Yasunaga 1989: 158; Stonedahl & Cassis 1991: 16; Schuh 1995: 626; Kerzhner & Josifov 1999: 49.

**Diagnosis**

Related to a Southeast Asian species, *F. inflatus* Stonedahl & Cassis. Although these two species are similar in general coloration and structure, the following characters distinguish two species: the antennal segment II of *F. collaris* is slightly shorter than the basal width of the pronotum, whereas the scutellum of *F. inflatus* is distinctly inflated and deflected posteriorly.

Dimensions. — ♂ / ♀: Body length 3.12/ 3.92; head width 0.68–0.75/ 0.67; length of antennal segment I 0.40–0.42/ 0.40, II 1.31–1.39/ 1.39, III 0.68–0.80/ 0.82, IV 0.49–0.58/ 0.50; basal pronotal width 1.27–1.42/ 1.47; maximum width across hemelytra 1.38–1.58/ 1.47; length of hind femur 1.17–1.30/ 1.23, tibia 1.50–1.67/ 1.72, tarsus 0.33–0.37/ 0.39.

**Distribution**

Japan (Ishigaki & Iriomote Is.), Laos, Thailand, South India.

Material examined. — JAPAN: Ryukyus: 1 ♀, Ishigaki Is., 2. iv. 1997, H. Yoshitake (NIAES); 1 ♀, Urasoko Trail, Ishigaki Is., 6. iii. 1999, K. Takahashi (NIAES); 1 ♂, Komi, Iriomote Is., 18. iii. 1977, Y. Hori (NSMT); 1 ♂, Shirahama, Iriomote Is., 5. iii. 1999, Y. Nakatani (NIAES).

***Fingulus takahashii* sp. n.**  
(figs. 4-5, 8, 11)

Type material. — Holotype ♂, Takeda, Ishigaki Is. Ryukyus, Japan, 25. VII. 1998, K. Takahashi (HUES). — Paratypes 8 ♀: JAPAN: Ryukyus: 1 ♀, Yona, Kunigami V., Okinawa Is., 23. v. 1993, light trap, Y. Nakatani (NIAES); 1 ♀, 23. vi. 1999, light trap, T. Ya-

sunaga, same locality (HUES); 1 ♀, Okunirindo, Kunigami V., 27. vi. 1999, T. Yasunaga (HUES); 1 ♀, Urasoko Trail, Ishigaki Is., 13. iii. 1999, K. Takahashi (HUES); 1 ♀, 26. vi. 1998, 1 ♀, 9. vii. 1998, same locality & collector as for holotype (HUES); 1 ♀, Otake, Ishigaki Is., 13. ii. 1999, same collector (HUES); 1 ♀, Ohtomi, Iriomote Is., 18. x. 1999, light trap, S. A. Belokobylskij (NIAES); 1 ♀, Yonaguni Is., 13. iv. 1997, T. Ishikawa (NIAES).

**Diagnosis**

Recognized by the slender body, reddish coloration and the pale yellowish brown antennae and legs. This new species is related to *F. porrecta* (Bergroth) described from Hong Kong, from which it can be distinguished by the larger body size (less than 4 mm in *F. porrecta*) and the longer head.

**Description**

Body remarkably elongate, slender; dorsum reddish brown, polished with dark punctures. Head reddish brown, porrect, strongly depressed; tylus strongly prominent; jugum, gena and gula slightly pale; junction of tylus and frons weakly inflated; vertex 0.20 (♂) / 0.27 (♀) times as wide as head; a longitudinal suture mesally; head (anterior to postocular furrow) 1.16 (♂) / 1.21 (♀) times as long as width including eyes; postocular furrow deep; postocular part elongate. Antenna pale yellowish brown, distinctly long; segment I reddish brown, thickened at basal 3/5; segment II slender, as thick as segments III & IV; lengths of segments I–IV (♂ / ♀): 0.55/ 0.58, 1.58/ 1.66, 0.94/ 0.89, 0.68/ 0.67. Labium yellowish brown, reaching at center of mesosternum.

Pronotum reddish brown, shining, weakly inflated, subtriangular in dorsal view, coarsely and distinctly furnished with dark punctures; pronotal collar broad, flattened, distinctly punctate, 0.37 (♂) / 0.36 (♀) times as wide as base of pronotum; callus smooth, polished; posterior margin strongly convex; basal width of pronotum 0.79 (♂) / 0.86 (♀) times as long as antennal segment II. Scutellum flattened. Pleura reddish brown, shining; pronotal xyphus yellowish brown, slightly swollen; ostiolar peritreme somber dark brown. Hemelytra reddish brown, shining; apical part of embolium red; cuneus red with pale lateral margin. Membrane pale brown with fuscous vein. Legs entirely pale yellowish brown; femora long and slender; length of hind femur, tibia and tarsus (♂ / ♀): 1.27/ 1.49, 1.66/ 1.94, 0.33/ 0.34; proportion of hind tarsomeres I–III as 8: 6: 7. Abdomen reddish brown, shining. Vesica with 2 small sclerites (fig. 11).

Dimension. (♂ / ♀). — Body length 4.06/ 4.76–5.17; head width 0.64/ 0.64; basal pronotal width 1.25/ 1.44; maximum width across hemelytra 1.25/ 1.55.

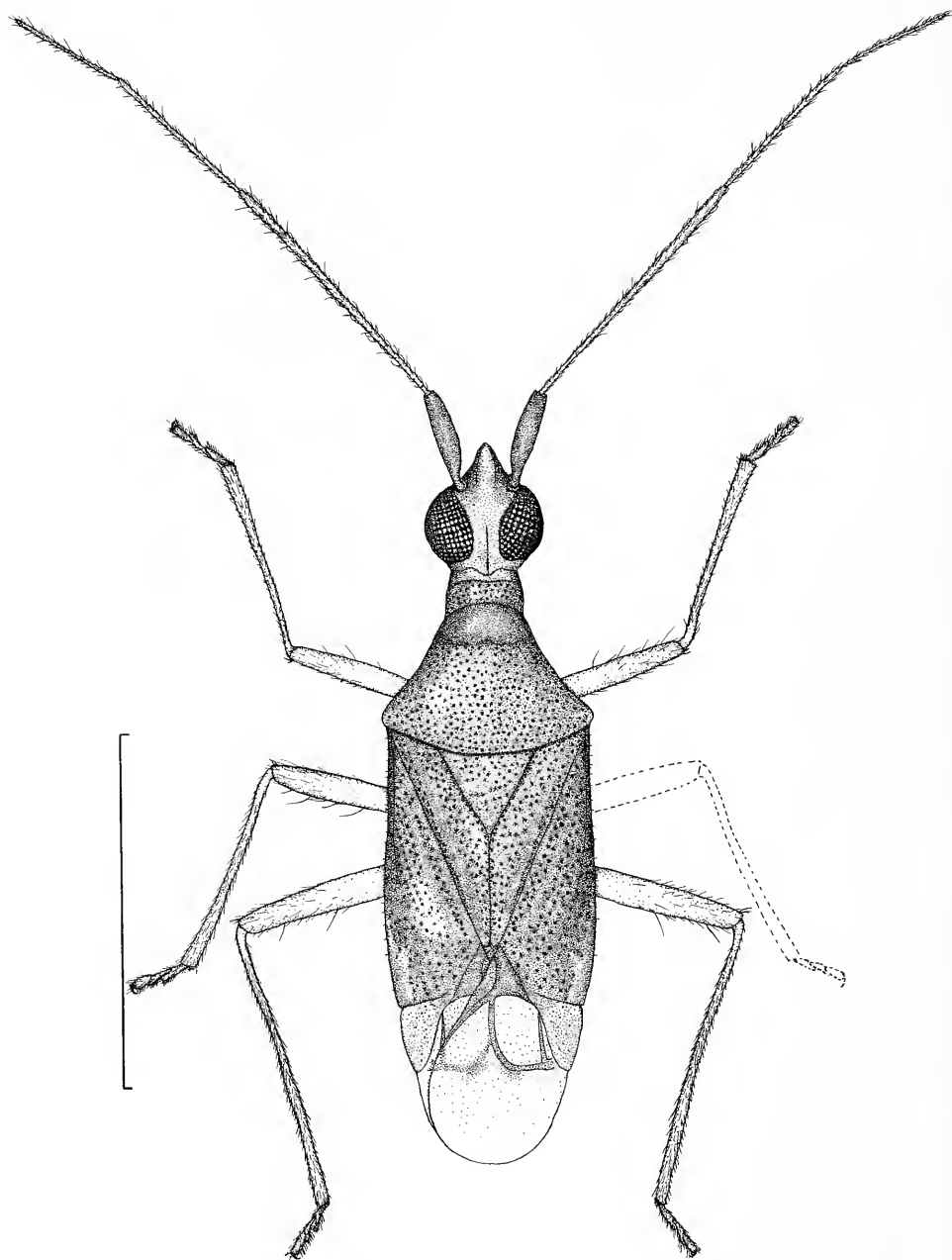


Fig. 5. *Fingulus takahashii*, holotype ♂, dorsal aspect. Scale: 2 mm.

### Etymology

Named in honour of Dr. K. Takahashi who collected and offered us several specimens of this new species.

### Distribution

Japan (Ryukyus; Okinawa, Ishigaki & Yonaguni Islands).

### *Cimidaeorus* Hsiao & Ren

*Cimidaeorus* Hsiao & Ren, 1983: 72, type species: *C. nigrorufus* Hsiao & Ren, 1983, monotypic; Schuh 1995: 599; Kerzhner & Josifov 1999: 34.

### Diagnosis

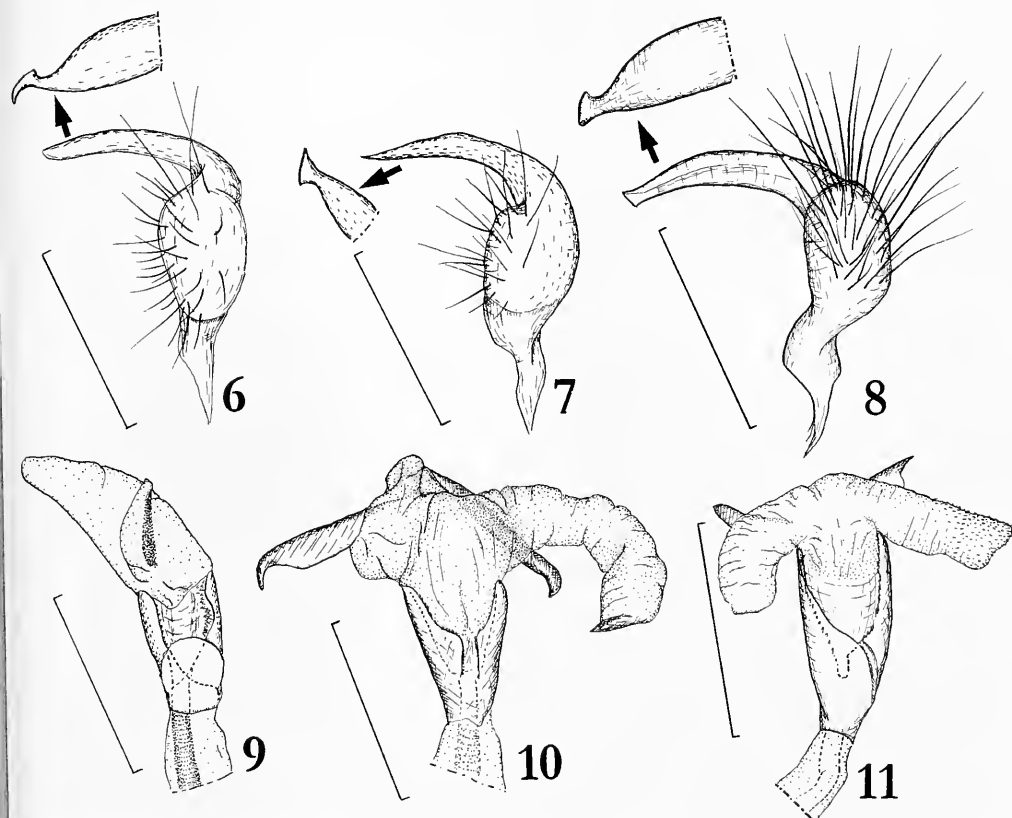
*Cimidaeorus* superficially resembles *Deraeocoris* Kirschbaum, 1855, from which it can be easily distinguished by the following combination of characters: thick and broad body, densely pubescent dor-

sum, small and setose compound eye, long and swollen antennal segment II, remarkably short segments III and IV, strongly carinate and extended lateral margin of the pronotum, tapered and rounded apical parts of the tibiae, and large, pointed protuberance on the sensory lobe of the left paramere.

### *Cimidaeorus basegawai* sp. n.

(figs. 12, 14-19)

Type material. – Holotype ♂, Kôrakuen, Tokyo, Honshu, Japan, 8. V. 1972, H. Hasegawa (NIAES). – Paratypes 1 ♂, 23 ♀: JAPAN: Honshu: 1 ♀, Iwakisan, 1,200-1,625m alt., Aomori Pref., 9. 7. vii. 1986, T. Ozaki (NIAES); 1 ♀, Shinrin Koen, Ogase, Saitama Pref., 2. v. 1990, H. Yatsu (NSMT); 11 ♀, same data as for holotype (NIAES); 1 ♀, Setagaya, Tokyo, T. Kimura (NIAES); 1 ♀, Nerima, Tokyo, 19. v. 1934 (NIAES); 2 ♀, Kumano Jinja, Ota, Tokyo, 20 v. 1996, Y.



Figs. 6-11. Male genitalia of *Fingulus* spp. – 6, 9, *F. longicornis*; 7, 10, *F. collaris*; 8, 11, *F. takahashii*, holotype. – 6-8, left paramere; 9-11, vesica. Scales: 0.2 mm.



12



13

Figs. 12-13. Adults on *Quercus acutissima*. – 12, *Cimidaeorus hasegawai*; 13, *Apoderaecoris decolatus*.

Kaneko et al. (NIAES); 1 ♀, Mitarai-ike, Ota, Tokyo, 23. v. 1996, same collector (NIAES); 1 ♀, Fuchu, Tokyo, 14. v. 1952, T. Fujimura (NIAES); 1 ♀, Okutama, Tokyo, 15. v. 1966, H. Kawata (NIAES); 2 ♀, Gakuencho, Sakai, Osaka, 28. iv. 1998, Y. Nakatani (HUES). – Kyushu: 1 ♀, Fukuoka City, 8. v. 1957 (MC); 1 ♂, Minami Park, Fukuoka C., 13. v. 1961, Mr. Shiga (MC).

### Diagnosis

Distinguished from the Chinese species, *C. nigrorufus*, by the following characters: the shorter body; black posterior margin of the pronotum; mostly black scutellum; more developed protuberance of the left paramere.

### Description

Body broad and thick; dorsum dark chestnut brown, with several, red markings, weakly shining, densely clothed with brownish, long, upright pubescence. Head blackish brown, shining, with densely distributed, silky, long pubescence; apical part of tylus somewhat pale; buccula somewhat pale, gula pruinose; vertex posteriorly with a red spot near each eye, sometimes continuous each other, 0.41-0.43 (♂)/0.49-0.54 (♀) times as wide as head; eyes setose. Antenna dark chestnut brown, densely setose; segment I thick; segment II remarkably long and tumid, in female, basal part slightly thinner than in male; segments III-IV minute; lengths of segments I-IV (♂/♀): 0.76-0.77/0.77-0.80, 2.06-2.45/2.07-2.60, 0.38-0.51/0.44-0.57, 0.36-0.42/0.36-0.44. Labium reddish brown, slightly reaching middle coxa; segments I-IV are similar in length.

Pronotum blackish brown, shining, distinctly and densely punctate, clothed with long, upright pubescence; pronotal collar blackish brown, shagreened,

convex, densely pubescent; callus as wide as collar, densely pubescent; mesal part of pronotum with a longitudinal red stripe, and lateral margin reddish in female. Scutellum dark chestnut brown, distinctly arched, impunctate, sparsely pubescent; lateral angle

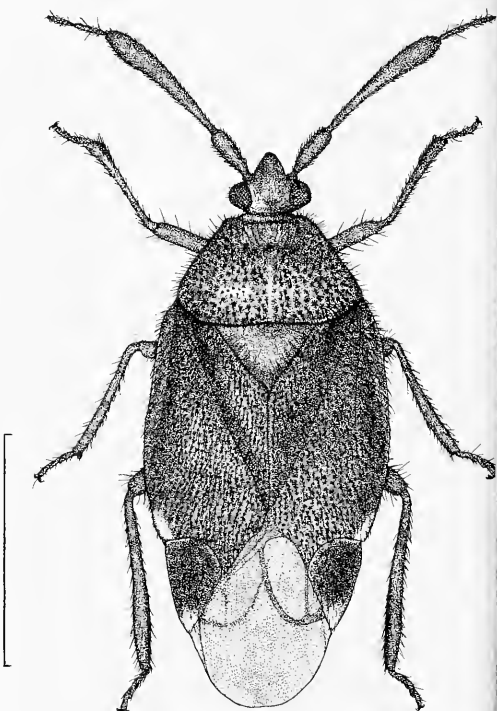


Fig. 14. *Cimidaeorus hasegawai*, holotype ♂, dorsal aspect. Scale: 3 mm.

slightly pale or tinged with red. Pleura entirely dull blackish brown. Hemelytra dark chestnut brown, weakly shining, punctures somewhat smaller than those on pronotum, densely furnished with upright pubescence; posterior angle of clavus pale or reddish brown; embolium somewhat pale or tinged with reddish, narrowly but obviously depressed; lateral and mesal margins of cuneus slightly pale or reddish brown. Membrane greyish brown. Legs dark reddish brown, short; each tibia densely setose, slightly tapered at apical 1/5; length of hind femur, tibia and tarsus ( $\delta$ /  $\eta$ ): 1.91-2.27/ 2.05-2.56, 2.35-3.08/ 2.65-3.37, 0.58-0.65/ 0.60-0.69; proportion of hind tarsomeres I-III ( $\delta$ /  $\eta$ ) as 25/ 24: 17/ 16: 26/ 24. Abdomen dark chestnut brown, densely pubescent. Male genitalia: Sensory lobe of left paramere with a large, pointed protuberance. Vesica with 5 sclerites. Female genitalia: Sclerotized ring mesally with a elongate process. Median part of posterior wall of bursa copulatrix narrow, with transverse, semicircular carina.

Dimensions ( $\delta$ /  $\eta$ ). – Body length 6.5-7.5/ 7.3-8.2; head width 1.2-1.3/ 1.3-1.4; basal pronotal width 2.5-2.9/ 2.7-3.6; maximum width across hemelytra 3.1-3.6/ 3.5-4.4.

### **Etymology**

Named in honour of Mr. H. Hasegawa who collected many specimens and observed the nymphal feeding habit of this new species.

### **Distribution**

Japan (Honshu, Kyushu).

### **Biology**

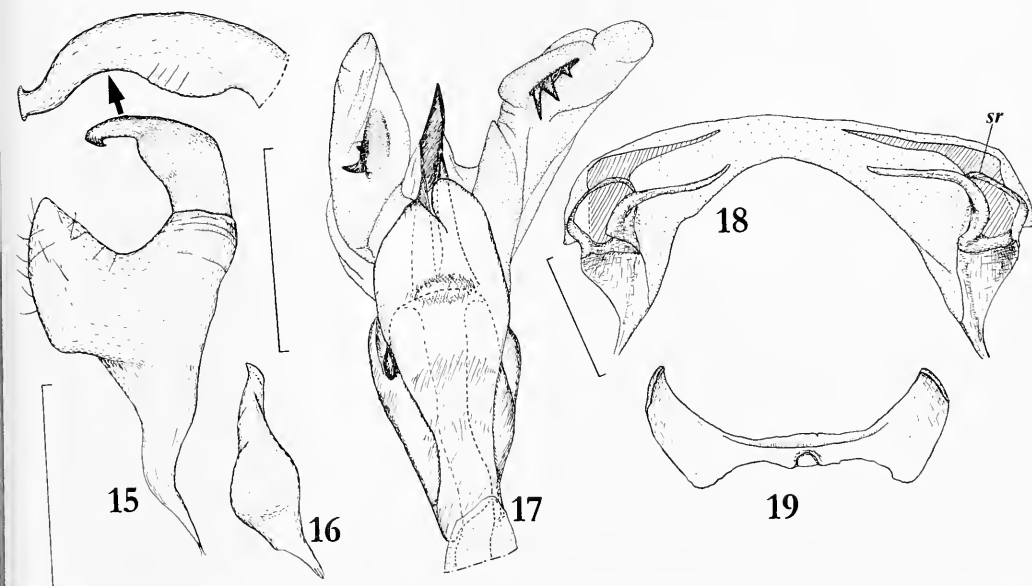
The nymphs of *C. hasegawai* resemble *Drosicha corpulenta* (Kuwana) (Homoptera, Margarodidae) which appears to be its prey (Hasegawa, unpublished observation).

### ***Apoderaeocoris* gen. n.**

Type species: *Apoderaeocoris decolatus* sp. n.

### **Diagnosis**

Recognized by the short, oval body, a large puncture near lateral margin of the each callus, carinate lateral margin of the pronotum, short tarsi, elongate protuberance of the left paramere, and highly sclerotized anterior region of bursa copulatrix.



Figs. 15-19. Male & female genitalia of *Cimidaeorus hasegawai* – 15, left paramere; 16, right paramere; 17, vesica; 18; dorsal view of bursa copulatrix, membranous part dissected; 19, posterior wall. – 15-17, holotype,  $\delta$ ; 18-19,  $\eta$ . Scales: 0.3 mm. Abbreviation: sr = sclerotized ring.

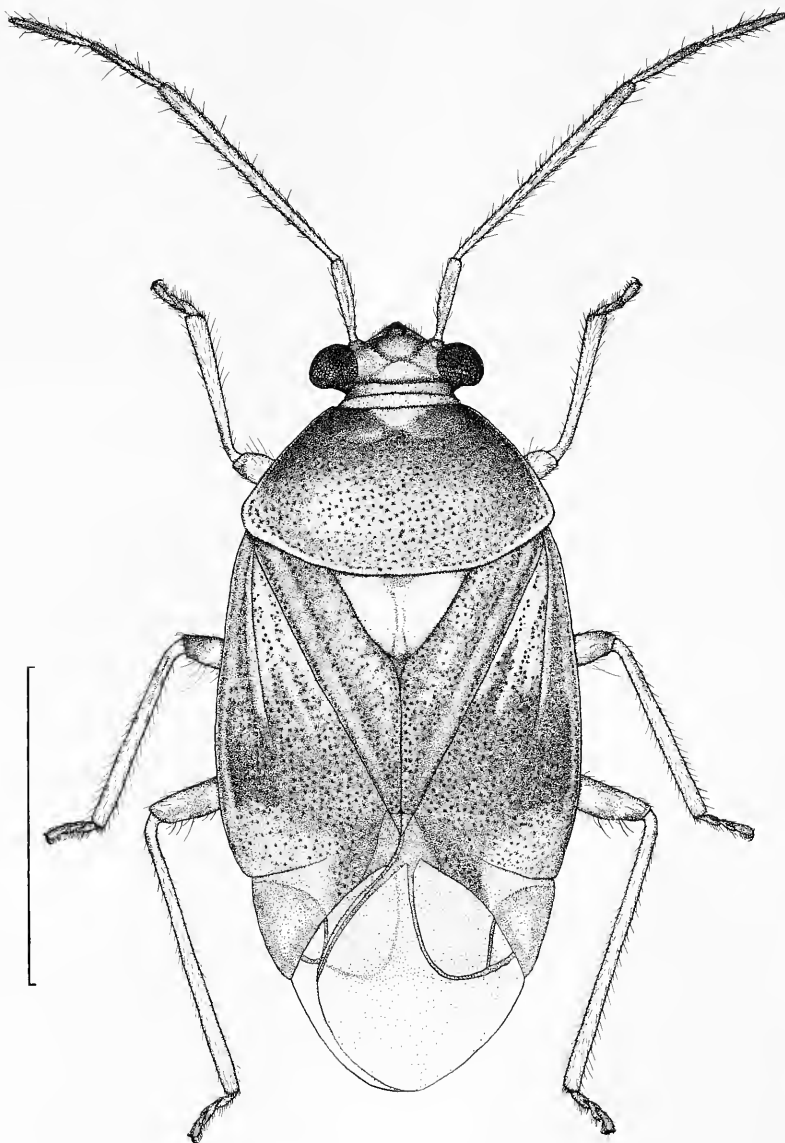


Fig. 20. *Apoderaeocoris decolatus*, holotype ♂, dorsal aspect. Scale: 2 mm.

# Description

Body short, oval; dorsum densely punctate. Head short, broad; tylus weakly projected; vertex broad, elevated slightly above level of eyes. Pronotal collar smooth. Callus furnished with a large puncture near lateral margin. Lateral margin of pronotum carinate. Scutellum impunctate. Legs short; tibiae without rows of spines; tarsi distinctly short, somewhat tumid. Abdominal sternites IV-VIII narrowed mesally. Male gen-

ital segment distinctly enlarged, occupying nearly half length of abdomen. Male genitalia: Left paramere semicircular; sensory lobe with elongate and setose protuberance; hypophysis flattened. Phallosome apically with a triangular plate. Female genitalia: Sclerotized rings accompanied by a pair of dorsal labiate plate; both lateral sides of bursa copulatrix strongly concave, into lobal structures toward mesally; large sclerotized plate on anterior region of bursa copulatrix.

## Discussion

Based on the genitalia (e.g., shape of the phallosome, presence of the inward lobal structures on both lateral sides of bursa copulatrix), *Apoderaeocoris* appears to be related to several species currently placed in *Deraeocoris*, such as *D. koreanus* Linnavuori and *D. kimotoi* Miyamoto. However, this new genus is significantly different from the type species of *Deraeocoris* (e.g., the broader and elevated vertex, the shorter tarsomeres, shape of the parameres, presence of the sclerotized plate on anterior region of the bursa copulatrix).

## *Apoderaeocoris decolatus* sp. n.

(figs. 13, 20- 27)

Type material. – Holotype ♂, Sameura, Motoyama T., Kochi Pref., Shikoku, Japan, 23. vii. 1996, Y. Nakatani (HUES). – Paratypes: 1♂, Hatori, Sakura C., Chiba Pref., 19. vii. 1997, M. Sano (CBM, ZI-76844); 1♂, 1♀, Kamishizu, Shakura C., Chiba Pref., 20. vii. 1997, same collector (CBM, ZI-76845, 76846); 1♀, Sagamihara C., Kanagawa Pref., 5. viii. 1958 (NIAES); 1♀, Son-enji, Hirakata C., Osaka Pref., 29. ix. 1993, Y. Nakatani (NIAES); 1♂, Sen-gokuso, Kaizuka C., Osaka Pref., 6. viii. 1996, light trap, Y. Nakatani (NIAES); 1♀, Mt. Mikusa, Inagawa T., Hyogo Pref., 19. vii. 1997, on *Quercus acutissima*, Y. Nakatani (NIAES); 1♀, Naratsu, Okayama C., 23. viii. 1996, S. Tsukaguchi (NIAES); 1♂, Miyoshi C., Hiroshima Pref., 28. vii. 1992 (NIAES). – Shikoku: 1♂, 1♀, same data as for holotype (HUES).

## Diagnosis

Recognized by the short body, yellowish brown coloration with brown and partly red markings, and short legs.

## Description

Body short; dorsum yellowish brown with dark markings, partly tinged with red, polished. Head pale yellowish brown, with a V-shaped, brown marking; apical and lateral margins of tylus reddish brown; posterior margin of vertex with reddish, transverse fascia; vertex 0.42-0.46 (♂)/ 0.48-0.50 (♀) times as wide as head. Antenna pale yellowish brown; segment I dorsally with a reddish stripe, that is sometimes reduced; lengths of segments I-IV (♂/ ♀): 0.46/ 0.51 1.53/ 1.52: 0.53/ 0.59: 0.65/ 0.58. Labium pale yellowish brown, reaching apex of middle coxa.

Pronotum dark chestnut brown, polished, coarsely and distinctly punctate except on calli; pronotal collar polished yellowish brown; calli medianly with a yellow triangular making, weakly elevated; lateral margin whitish yellow, carinate; posterior margin narrowly, or sometimes widely, yellowish brown; basal

width of pronotum 1.32 (♂)/ 1.29-1.32 (♀) times as long as antennal segment II. Scutellum yellowish brown, with a red, longitudinal stripe that sometimes becomes indistinct. Pleura somber yellowish brown; prosternum pale; ostiolar peritreme yellowish white. Hemelytra yellowish brown, widely infuscate, impunctate several yellowish white stripes, with dark punctures; clavus with lateral, distinct stripe and weak stripe inner; corium with 3 whitish, partly fused stripes anteriorly; embolium with 2 white stripes; lateral margin of embolium narrowly red; cuneus yellowish brown, with red lateral and inner margins. Membrane greyish brown; veins fuscous, with reddish part near cuneus. Legs pale yellowish brown, short; femora thick, partly tinged with red; tarsi short, somewhat thick; lengths of hind femur, tibia and tarsus (♂/ ♀): 1.44/ 1.45, 1.78/ 1.86, 0.34/ 0.40; proportion of hind tarsomeres I-III (♂/ ♀) as 15/ 17: 13/ 14: 16/ 19. Abdomen reddish brown. Male genitalia: Sensory lobe of left paramere with a thick protuberance and emarginate ventral surface; hypophysis strongly curved and gradually flattened towards apex and bearing a row of short, erect setae, furnished apically with a small, cuneate process. Phallosome apically with triangular plate. Vesica with 5 sclerites (fig. 24). Female genitalia: Anterior region of bursa copulatrix with a large plate and a pair of plate (fig. 26).

Dimensions (♂/ ♀). – Body length 4.3-4.6/ 4.7-4.9; head width 1.0 / 1.0; basal pronotal width 2.0/ 2.0-2.2; maximum width across hemelytra 2.3/ 2.7-2.8.

## Distribution

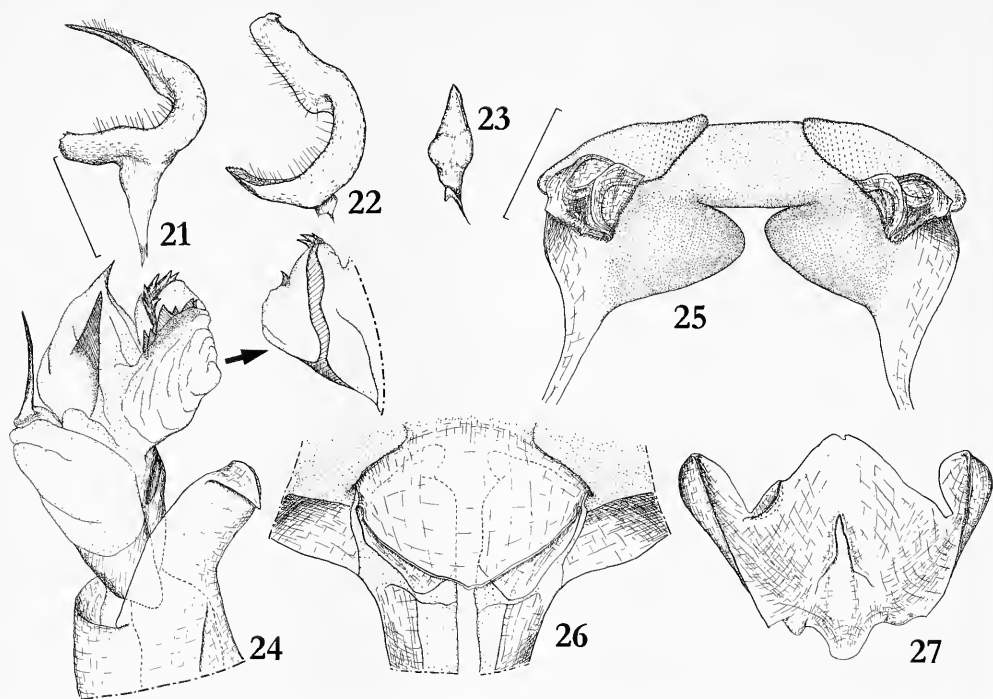
Japan (Honshu, Shikoku).

## Biology

This new species is associated with *Quercus acutissima* Carruthers (Fagaceae), on which both adults and nymphs were collected. One generation per year is assumed for this mirid.

## ACKNOWLEDGEMENTS

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Figs. 21-27. Male & female genitalia of *Apoderaeocoris decolatus* – 21-22, left paramere; 23, right paramere; 24, phallus; 25; dorsal view of bursa copulatrix, membranous part dissected; 26; ditto, anterior view; 27, posterior wall. – 21-24, holotype ♂; 25-27, ♀. Scales: 0.3 mm.

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# GEOGRAPHICAL VARIATION IN MORPHOLOGY AND ASYMMETRY IN *EPISYRPHUS BALTEATUS* DEGEER (DIPTERA: SYRPHIDAE)

Sullivan, M. S. & J. P. Sutherland, 2000. Geographical variation in morphology and asymmetry in *Episyrphus balteatus* DeGeer (Diptera: Syrphidae).— *Tijdschrift voor Entomologie* 142 (1999): 327–331, tables 1–3. [ISSN 0040-7496]. Published 11 April 2000.

An examination was conducted of morphological variation in *Episyrphus balteatus* (DeGeer) (Diptera: Syrphidae) from nine sites in the UK, Germany, Morocco and Madeira. Variation in total length, thorax width, wing length and asymmetry in wing length (males exhibited directional asymmetry, while females exhibited fluctuating asymmetry) was reduced to two factors (using principal components analysis), one of which represented size and the other asymmetry. These factors were then used in analyses of variance between sites. There was significant variation in size but not asymmetry between sites for both males and females. Post-hoc comparisons suggest that Madeiran males are relatively small, and females from one UK site were relatively large, but that overall there is considerable homogeneity between sites. We tentatively suggest that the Madeiran population may be resident. Correspondence: Correspondence: Matthew S. Sullivan, Behavioural and Environmental Biology, Department of Biological Sciences, the Manchester Metropolitan University, Chester Street, Manchester, M1 5GD, United Kingdom. E-mail: M.Sullivan@mmu.ac.uk

Key words. — *Episyrphus balteatus*; Syrphidae; fluctuating asymmetry; morphology; variation.

Species with ranges encompassing a wide range of ecological conditions, such as might be found over a large geographical range, often show local adaptation to those conditions, which may be reflected in external morphology. An aspect of morphology which has received attention recently is asymmetry, and more particularly, fluctuating asymmetry (FA) (some recent reviews include Leary & Allendorf 1989, Clarke 1993, 1995, Møller & Swaddle 1997, Møller & Thornhill 1997).

FA is a measure of the deviation from perfect symmetry of a character that is, on average, symmetrical on both sides of the body (Ludwig 1932, Van Valen 1962). It is considered to indicate a perturbation of development, so it follows that this is a useful indicator of stress experienced by an organism during development. 'Stress' can be regarded as both genetic and environmental stresses, extensive examples of which are given in a review by Leary & Allendorf (1989). Parsons (1990) lists genetic stresses as inbreeding, hybridization and increasing levels of homozygosity and examples of environmental stresses as food deficiency, parasites and pathogens, audiogenic stress and pesticides. Variation in FA at the population level is interpreted with reference to such stressors (e.g., Oxnevad et al., 1995, Wauters et al. 1996), but studies which consider variation in FA within populations are less

common (Møller 1995a, b; Sullivan 1998). Given that FA shows variation within and between populations, it is potentially a useful character in helping to detect heterogeneity in populations.

*Episyrphus balteatus* Degeer has a large distribution, given by Peck (1988) as: Europe and the former Soviet Union; Asia: Afghanistan, Mongolia, China, Japan; North Africa: Algeria, Egypt; Azores, Canary Islands; Oriental Region; Australia. It has several generations per year and overwinters as an adult female (Dusek & Laska 1986). The larvae are aphidophagous and the adults are significant pollinators, both of which make this a species of applied interest. Within Europe the population may be migratory, moving north in the spring and south in late summer and autumn (Overgaard-Nielsen 1968, Svensson & Janzon 1984). Indeed, the majority of some northern populations, such as the British, may be migratory rather than resident (Stubbs & Falk 1983, Verlinden & DeCler 1987). This would tend to disrupt local adaptation, possibly reflected in morphological homogeneity across European populations.

We present an analysis of geographical variation in *E. balteatus*, including for the first time consideration of asymmetry, to investigate the extent of homogeneity in this species in Europe, Morocco and Madeira.

# METHODS AND MATERIALS

Samples of *E. balteatus* were collected from a number of different sites in Britain and Europe, by hand netting and Malaise trapping.

The localities were :

- i Lower Moss Wood, Knutsford, Cheshire, UK, SJ782751 (53°16'N, 2°19'W) (1994 and 1995). A small area (15ha) of mixed deciduous woodland surrounded by dairy pasture.
- ii Fletcher Moss Gardens, south Manchester, UK, SJ845905 (53°24'N, 2°14'W) (1994). A small area of suburban botanic gardens.

- iii Dairy House Farm, Ashley, Cheshire, UK, SJ779849 (53°22'N, 2°20'W)(1995). A mixed arable farm (cereals and rape) with adjacent area of mature mixed deciduous woodland alongside River Bollin.
- iv University of Exeter Nature Reserve, Exeter, Devon, UK, SX915944 (50°44'N, 3°32'W)(1995). A mixed deciduous woodland.
- v IACR-Rothamsted, Harpenden, Hertfordshire, UK; TL125135 (51°49'N, 0°23'W) (1994, 1996). A mixed arable farm.
- vi Rostherne Mere NNR, Cheshire, UK, SJ745842 (53°21'N, 2°23'W). A freshwater lake surrounded by mixed arable farmland and woodland.

Table 1. Summary data on *Episyrphus balteatus* collected from 9 sites in the UK, Europe, Morocco and Madeira. Year and week numbers of collection are given, where week 1=1-7 Jan, week 2=8-14 Jan etc. Wing length data are based on the mean of the left and right wings per individual.

Site	TRAIT	MALES			FEMALES			ALL		
		n	mean	s.e.	n	mean	s.e.	n	mean	s.e.
Lower Moss Wood 1994 week 29 1995 week 33	length	41	10,75	0,13	7	9,74	0,32	48	10,6	0,13
	thorax width		2,53	0,03		2,18	0,08		2,48	0,04
	wing length		9,58	0,1		9,26	0,39		9,53	0,1
Fletcher Moss Gdns. 1994 week 31	length	25	10,91	0,14	8	10,62	0,1	33	10,84	0,11
	thorax width		2,53	0,04		2,21	0,01		2,45	0,04
	wing length		9,97	0,12		10,1	0,15		10	0,1
Rothamsted 1994 week 26	length	0			9	10,58	0,2	9	10,58	0,2
	thorax width					2,07	0,05		2,07	0,05
	wing length					9,37	0,21		9,37	0,21
Exeter 1995 week 28	length	25	10,85	0,13	12	10,03	0,17	37	10,58	0,12
	thorax width		2,44	0,04		2,07	0,04		2,32	0,04
	wing length		9,82	0,12		9,37	0,21		9,68	0,1
Ashley 1995 weeks 27, 30-32	length	25	10,84	0,12	23	10,08	0,13	48	10,48	0,1
	thorax width		2,5	0,04		2,19	0,03		2,35	0,03
	wing length		9,71	0,1		9,44	0,11		9,58	0,07
Rostherne 1996 weeks 30-33, 36	length	47	10,32	0,12	50	9,7	0,1	97	10,04	0
	thorax width		2,43	0,03		2,18	0,02		2,3	0,02
	wing length		9,68	0,11		9,58	0,1		9,63	0,07
Funchal, Madeira 1996 week 13	length	9	9,91	0,18	10	8,99	0,28	19	9,42	0,2
	thorax width		2,32	0,04		2,02	0,09		2,16	0,06
	wing length		9,36	0,15		9,15	0,26		9,25	0,15
Ourigane, Morocco 1996 week 14	length	25	10,84	0,13	25	10,46	0,13	50	10,65	0,1
	thorax width		2,52	0,03		2,25	0,03		2,39	0,03
	wing length		10,07	0,11		10,01	0,11		10,04	0,08
Alte Sorge, Germany 1996 week 35	length	19	10,26	0,27	0			19	10,26	0,27
	thorax width		2,52	0,07					2,52	0,07
	wing length		9,61	0,2					9,61	0,2
<b>TOTALS</b>	length	216	10,63	0,05	144	10,01	0,06	360	10,38	0,04
	thorax width		2,48	0,01		2,17	0,01		2,36	0,01
	wing length		9,74	0,04		9,59	0,06		9,68	0,04

- vii Alte Sorge, 30km west of Kiel, Schleswig Holstein, Northern Germany (54°21'N, 9°24'E) (provided by Christian Kassebeer, Zoologisches Institut, University of Kiel, Germany).
- viii Ouirgane, 15km south of Asni, Atlas Mountains, Morocco (31°14'N, 7°55'W) (provided by Christian Kassebeer).
- ix Funchal, Madeira, (32°38'N, 16°53'W) (provided by Martin Jones, Manchester Metropolitan University, UK).

Measurements were taken (following Speight, 1987) of: 1) total length (from the frons to the tip of the abdomen); 2) thorax width; 3) total wing length. Measurements were all taken using digital Vernier calipers to the nearest 0.01 mm under a dissecting microscope. To attempt to quantify and control for measurement error, six repeated measurements were made. Sample sizes are given in table 1. All statistical analyses were as implemented by SPSS v8.0.

## RESULTS

A total of 360 flies were measured from the nine sites and summary statistics are given in table 1. Males were significantly longer and had wider thoraxes than females across all sites (t-tests,  $p < 0.001$ ). Males also had longer wings than females (t-test,  $p = 0.034$ ). There were no relationships between total length, thorax width and total wing length and date of collection (linear regressions with week number as the independent variable all n.s.)

### Fluctuating asymmetry

The asymmetry values for wing length (calculated as left-right (Palmer & Strobeck 1986)) were examined firstly for directional asymmetry and to quantify the amount of FA free from measurement error. The

Table 3. Factor scores for males and females derived after entering four morphological characters.

Character	Males		Females	
	Factor 1 scores	Factor 2 scores	Factor 1 scores	Factor 2 scores
length	0,947	-0,001	0,915	0,008
thorax width	0,932	0,002	0,912	0,105
wing asymmetry	-0,002	0,999	0,009	0,995
wing length	0,945	-0,007	0,942	0,009
Cumulative percent variation explained	66,50%	91,60%	66,00%	89,50%

data were broken down by sex, and two-way mixed model ANOVAS (sides[fixed] by individuals[random]) used (Palmer & Strobeck 1986, Merila & Bjorklund 1995, Sullivan 1998). Tables 2a and 2b show that for males there was a significant sides component indicating directional asymmetry, but not for females, indicating fluctuating asymmetry. Further analyses of FA are therefore restricted to females. For females, the magnitude of FA free from measurement error is given by  $((MS_{\text{interaction}} - MS_{\text{error}})/\text{number of repeated measures})$ , which in this case is 0.1%. This asymmetry was normally distributed (Kolmogorov-Smirnov test for normality, n.s.) with a mean not different from zero (one-sample t-test, two-tailed, n.s.), again confirming that the type of asymmetry exhibited was FA.

It is of interest in this paper whether there is any difference in magnitude of FA at different sites. For this, we shall use the unsigned FA, which has a half-normal distribution. This would initially suggest that non-parametric statistical tests should be employed. However, Gangestad & Thornhill (1998) have demonstrated that significance tests on parametric correlations involving FA are robust, and so we use parametric tests to address these questions for maximum power.

### Variation in size and asymmetry between sites

The variables total length, thorax width, total wing length and absolute wing asymmetry were put into a principal components analysis to reduce these dimensions to two independent factors. Males are now reintroduced into the analyses because the magnitude of asymmetry is of interest, not whether it is fluctuating or directional. Males and females were analysed separately and the results of this shown in table 3. Wing length per individual is calculated as (mean of the 6 repeats of left wing + mean of the 6 repeats of right wing)/2. For both sexes factor 1 is dominated by total length, thorax width and total wing length, while factor 2 is dominated by wing asymmetry.

Oneway analysis of variance, with week of collection as a covariate, was used to see if there was signif-

Table 2. Two-way mixed model ANOVA for estimation of directional asymmetry and fluctuating asymmetry in wing length for (a) females and (b) males.

(a) Females				
Source	DF	MS	F	P
Individuals	143	5,588	3904,5	0,000
Sides	1	1,13E-05	0,008	0,929
Interaction	143	2,00E-02	13,92	0,000
Within cells	1440	1,43E-03		
(b) Males				
Source	DF	MS	F	P
Individuals	215	5,146	3449,2	0,000
Sides	1	2,16E-02	14,51	0,000
Interaction	215	2,08E-02	13,91	0,000
Within cells	2160	1,49E-03		

icant variation between sites in the factor scores derived above. For males there was significant variation between sites in factor 1 ( $F=2.29$ , d.f. 7, 207,  $p=0.023$ ), but not factor 2 ( $F=1.66$ , d.f. 7, 207, n.s.). Post-hoc tests (using Tamhane's T2 test, which does not assume equal variances) reveal significant pairwise differences in factor 1 scores between Madeira and each of Ashley, Fletcher Moss Gardens and Morocco. For females there were significant differences between sites in factor 1 scores ( $F=3.83$ , d.f. 7, 135,  $p=0.001$ ) but not for factor 2 scores ( $F=0.761$ , d.f. 7, 135, n.s.). Post-hoc comparisons for factor 1 scores revealed significant pairwise differences between Fletcher Moss Gardens and each of Exeter and Rostherne.

## DISCUSSION

Our interest in asymmetry for the purpose of this paper is to see if it improves our ability to detect heterogeneity between sites. Some studies have found spatial and clinal variation in asymmetry (see Møller & Swaddle 1997), but we found no significant variation. Indeed, the overall picture that emerges is one of homogeneity in morphology of *E. balteatus* in the samples measured, with a small number of exceptions. The Madeiran males are smaller than those of two UK sites and of Morocco, while within the UK females from Fletcher Moss Gardens are larger than females from Exeter and Rostherne. Reasons for these differences might include sampling error resulting in non-representative individuals being taken, or stochastic effects acting on the population such as variation in larval prey availability (Rojo et al. 1996). These are difficult to exclude from the present study, and may well explain the relatively large size of the Fletcher Moss Gardens females, although there was no relationship with week of capture. The relatively small Madeiran males are intriguing, however.

The Madeiran fauna is well known for insular effects such as the large proportion of flightless carabid beetles (Darwin 1859) and other insects (Roff 1990). There may be a number of possible reasons why the Madeiran males are relatively small, including environmental and stochastic factors. One other reason might be that this population is resident, selection pressure for migratory ability is relaxed and local adaptation has resulted in smaller body size for males. Females may remain under the overall selection pressure for larger body size due to its relationship with fecundity. We therefore tentatively suggest that the homogeneity of the European and Moroccan samples provide evidence for movement of individuals across the region, disrupting local adaptation, while the Madeiran population is resident. This must remain little more than speculation at present, with further work required looking at a wider range of morpho-

logical characters, including banding patterns, but more particularly looking at genetic variation across the range.

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## BOOK REVIEWS

K.F. Efetov & G.M. Tarmann, 1999. Forester moths. The genera *Theressa* Strand, 1917, *Rhagades* Wallengren, 1863, *Jordanita* Verity, 1946, and *Adscita* Retzius, 1783 (Lepidoptera: Zygaenidae, Procridinae). – Apollo Books, Stenstrup, 192 pp, 12 colour plates. Hardback [ISBN 87-88757-23-4]. Price DKK 460 ex p&cp.

'Forester moths' is a revision of the Zygaenid genera mentioned in the subtitle, in total 63 West and Central Palearctic species. The descriptions are concise and accompanied by detailed drawings of genitalia and watercolours of moths. There are also detailed keys. The publication of this book almost simultaneously with the Zygaenid handbook by Naumann et al. is somewhat odd: there is a big overlap, as 44 species are treated in both books, and Naumann et al. give many more details of the species they treat.

This book is printed on a thicker type of old-fashioned, yellowish paper. It makes the book look thicker, but it is a pity that this paper is also used for the beautiful colour plates: this paper can absolutely not give any natural impression of these very shining moths. Otherwise the colour plates are beautiful, and give a good impression of the moths, caterpillars, their biology and habitats. This book can best be regarded as an addition to Naumann et al. for the interested taxonomists and collectors.

[E.J. van Nieukerken]

Irma Wynhoff, Chris van Swaay & Jan van der Made, 1999. Veldgids dagvlinders. – KNNV Uitgeverij, Hardback. [ISBN 90-5011-123-8]. Price NLG 50 excl. p&cp. [Field-guide Butterflies, in Dutch]

This field guide deals with the 146 species of butterflies occurring in Northwest Europe: Netherlands, Belgium, Luxembourg, Great-Britain and Ireland, Denmark, Germany except the Alps and northern France. It is the successor of the earlier guide to the Dutch and Belgian species. This book, being in Dutch, is mainly for Dutch and Belgian readers, but foreigners can use the book as a picture atlas. It provides both scientific names and trivial names in Dutch, French, German and English. It is a pity that no Latin names of hostplants are given, but the five species of host ants (*Myrmica*) for *Maculinea* are described and illustrated in detail.

This guide is attractively designed, although I find the purple squares connecting the different pho-

tographs of the same species too much: they distract from the butterfly. Also I would have preferred slightly magnified photo's for the smaller blues instead of the natural size.

In short: a nice addition to the European field-guides, worth its money.

[E.J. van Nieukerken]

Karel Špatenka, Oleg Gorbunov, Zdeňek Laštůvka, Ivo Tošovský & Yutaki Arita, 1999. Sesiidae - Clearwing moths. – Handbook of Palearctic Macrolepidoptera (managing editor Clas M. Naumann), volume 1. 592 pp., 487 colour illustrations. Hardback, with dust jacket. Gem Publishing Company, Brightwood UK. [ISBN 0 906802 08 3]. Price £120.

This is the long awaited first volume of a new ambitious series to replace the out-dated books by Seitz. This is in every meaning of the word a heavy weight. The main specialists working in the Palearctic region have come together to redescribe the 309 species of clearwings in a very thorough way. Still, the format of the book is concise and practical, for instance omitting long material lists. The backbone of the book is formed by beautiful watercolours of the moths by Bohumil Stary, Ruth Holzinger and Frantisek Gregor. The drawings of genitalia are reproduced rather small, but sufficient enough to show the details. For all the species a small distribution map is presented (very similar to those of the Zygaenid book reviewed above). By looking at these maps, especially for regions without sea, I was sometimes at a loss to identify the region, because no borders or rivers are drawn, just the major lakes. Adding borders would have provided more points for recognition, may be something to improve in future volumes? Another thing I miss are some more illustrations on biology and habitats. A few colour plates with larvae, their damage and some typical habitats could have enlarged the information contents.

In summary: an important landmark in the study of Sesiidae and good start of a new series on Macrolepidoptera (although I personally regard Sesiidae as typical Microlepidoptera!). The high price may prevent this book to get a very high dispersal, but is reasonable for a book of this size and good printing quality.

[E.J. van Nieukerken]

# REVISION OF THE ORIENTAL GENERA OF PLASTOTEPHRITINAE (DIPTERA: PLATYSTOMATIDAE)

Whittington, A. E., 2000. Revision of the Oriental genera of Plastotephritinae (Diptera; Platystomatidae). – *Tijdschrift voor Entomologie* 142 [1999]: 333–344, figs. 1–30. [ISSN 0040-7496]. Published 11 April 2000.

The Oriental genera and species of Plastotephritinae (Diptera: Platystomatidae) are revised. A key to genera in the Oriental Region is provided and diagnoses are given for the only two genera known to occur there, namely *Agadasys* gen. n. and *Rhegmatosaga* Frey, 1930. One new species, *Agadasys hexablepharis* sp. n. is described. Only seventeen specimens are available for this subfamily from the Oriental Region. The scarcity of the material available is thought to be a result of low collecting effort rather than due to scarcity, since collecting localities are widely distributed.

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Keywords. – Diptera, Platystomatidae; Plastotephritinae; *Rhegmatosaga*; *Agadasys* gen.n.; key; new species; Oriental.

Little attention has been given to the Platystomatidae subfamily Plastotephritinae on a world-wide basis since Hendel (1914a, b), Enderlein (1922, 1924) and Frey (1932). Most species are distributed in the Afrotropical Region and the Oriental fauna of this subfamily is small and consequently there has been no Oriental revision, nor much need for one.

Frey (1930) described *Rhegmatosaga insignis* and later (1932) included *Rhegmatosaga* in his key to the African genera of the Plastotephritinae. *R. insignis* was correctly synonymised with *Noeeta latiuscula* (Walker, 1856) by Hardy (1959). The genus was again mentioned by Steyskal in the Catalog of the Diptera of the Oriental Region (Steyskal in Delfinado & Hardy 1977), listing the single nominate species *R. latiuscula*. Here, Steyskal also listed an unnamed species from South Vietnam and Thailand, based on information from D.K. McAlpine at the Australian Museum.

As part of a wider revision of the subfamily Plastotephritinae, large amounts of undetermined material have now been examined and the results are ready for presentation. The provenance of most of this material is Afrotropical and will be presented in a series of papers discussing the fauna of that region. Nevertheless, the scarcity of material coming from the Oriental region is remarkable. There are only 17 specimens known for the Plastotephritinae from eight

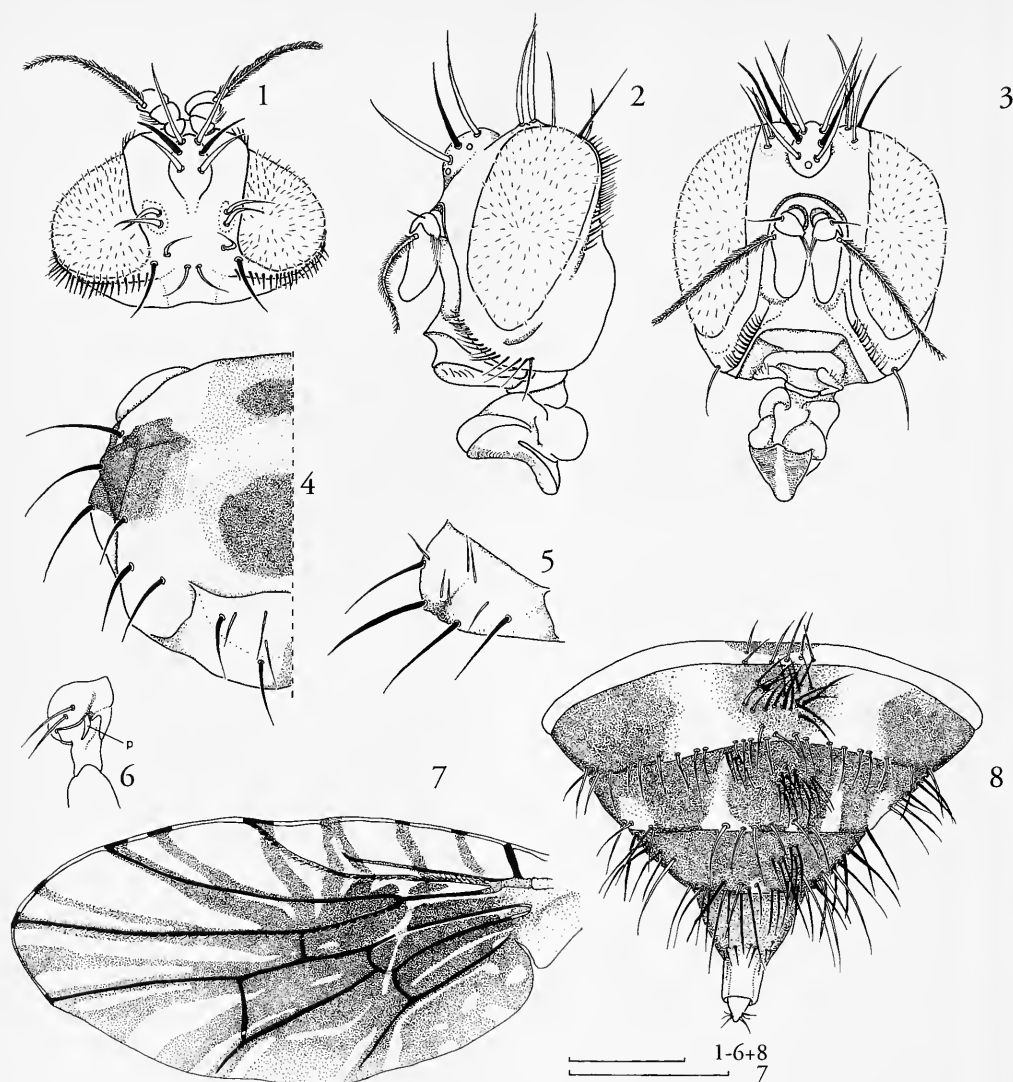
different localities and held in five institutions. It is possible that this is partly caused by low collecting effort and difficulties arising in sorting specimens of Plastotephritinae from other subfamilies and families.

Examination of these few specimens has led to the recognition of a new genus, described here. To place this new genus in context and to make diagnosis of *Rhegmatosaga* clearer, a redescription of the latter genus is also included. The unnamed species from South Vietnam and Thailand (Steyskal in Delfinado & Hardy 1977) belongs in the new genus, although both genera are known from Vietnam. Thus, there are two genera in the Oriental Region, each with a single known species.

## TECHNIQUES

Descriptions are based on primary type specimens. Bilaterally symmetrical features are described in the singular. Variable character states and measurement ranges, such as those of body and wing lengths, are listed under a separate heading. The measurement of body length excluded female ovipositors where these were excluded.

Terminology and abbreviations concerning gross morphology generally follow Crosskey (1984) and D. K. McAlpine (1973). Details of the post abdomen follows D. K. McAlpine (1973) and Munro (1947), with modification from Cumming et al. (1995). I



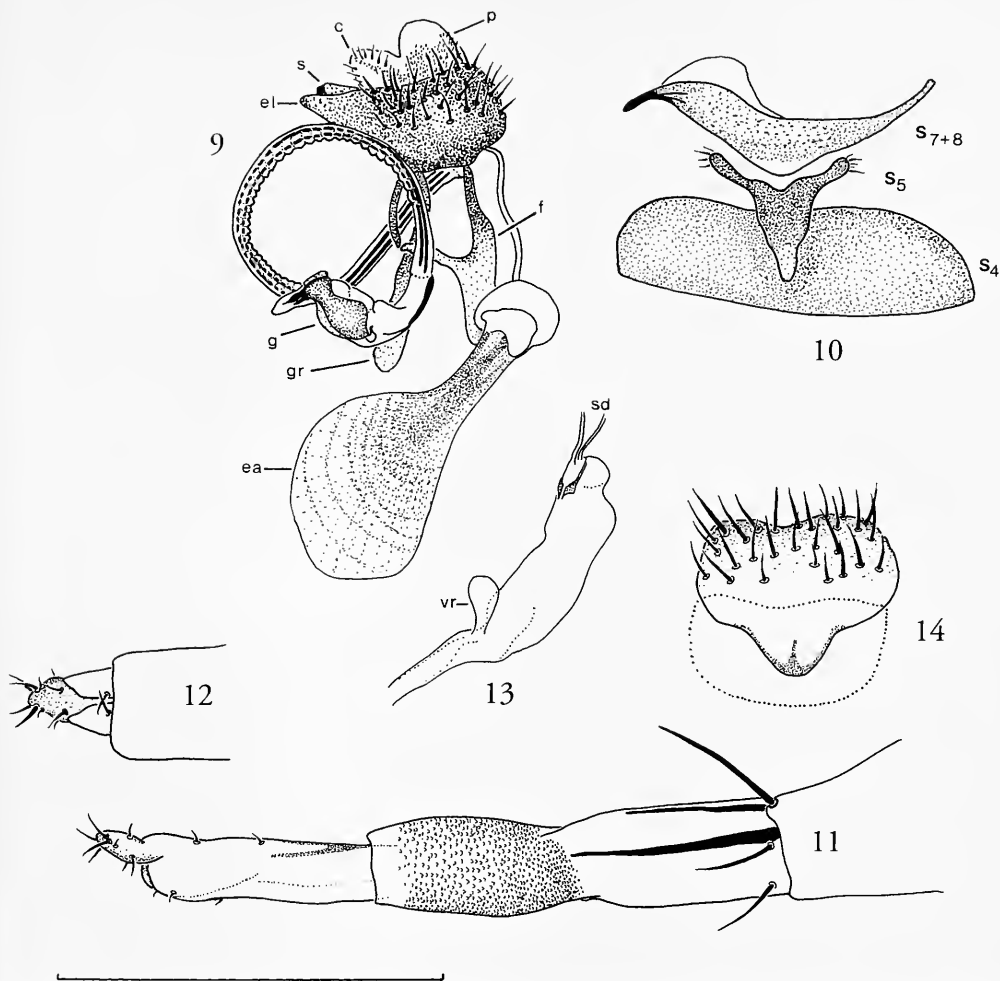
Figs. 1-8. *Agadasys hexablepharis* sp. n. – 1, head in dorsal view; 2, Head in lateral view; 3, head in frontal view; 4, left half of thorax in dorsal view; 5, scutellum viewed obliquely from the right; 6, left mid-coxa; 7, left wing in dorsal view; 8, abdomen in slightly oblique dorsal view. – Abbreviations: p, midcoxal prong. Scale bars = 1mm.

have followed J. F. McAlpine (1981) in the usage of meron for hypopleuron or meropleuron and subcutellum for postscutellum. Bristles are generally strongly developed, being considerably thicker and often differently coloured compared to the surrounding setulae. Usually bristles can be clearly separated from setulae in *Plastotephritinae*.

Drawings were made with the aid of a stereomicroscope and a drawing tube. Only bristles and major se-

tulae were illustrated, with the result that illustrations for the new genus appear less setose than the specimens.

After suitable relaxation of the specimens, genitalia were dissected and then cleared in hot potassium hydroxide for about ten minutes, rinsed in 70% alcohol, viewed and then stored in glycerine. The male postabdomen is flexed to a position beneath tergite four and is thus inverted. The descriptions relate to



Figs. 9-14. *Agadasys hexablepharis* sp. n. postabdominal structures – 9, male genitalia in lateral view; 10, internal view of terminal sternites of male genitalia; 11, female genitalia in lateral view; 12, apex of aculeus in ventral view; 13, female internal genital tract; 14, sternite 6 of the female in ventral view, dotted line shows position of  $S_5$  (removed). – Abbreviations: c = cercus; ea = ejaculatory apodeme; el = epandrial lobe; f = fultella; g = glans; gr = genital ring; p = proctiger; S + number = sternite; s = surtylus; sd = spermathecal ducts; vr = ventral receptacle. Scale bars = 1 mm.

the 'upright' position in which the cerci are in the dorsal position, rather than in the inverted ventral position. Furthermore, the illustrations were drawn with cerci in the dorsal position.

Specimens used in this paper were borrowed from the following institutions:

- AMSA Australian Museum, Sydney, Australia.  
BMNH The Natural History Museum, London, England.  
BPBM Bernice Pauahi Bishop Museum, Honolulu,

U.S.A.

- MZHF University Zoological Museum, Helsinki, Finland  
USMN United States National Museum, Washington, U.S.A.

#### SUBFAMILY PLASTOTEPHRITINAE

Members of the subfamily Plastotephritinae can be differentiated from the other families of Platystomati-  
dae, by the following subset of characters:

- subcosta angled forward distally
- lower calypter reduced to a narrow, linear fringe along the post-alar wall
- tergites four and five of approximately the same length as tergite three in both sexes
- aedeagus having a glans (at least partly sclerotized) without terminal filaments; in some genera terminal claws and lobes are observed.
- female abdomen having tergite 6 absent or vestigial and concealed in a membranous fold below tergite five
- female aculeus variable between broad with an acute apex, and slender with a rounded apex.
- There is a tendency for the head to be flattened anteroposteriorly and the face to be concave and thrust forward at the buccal margin. Some genera of Trapherinae and Platystomatinae also have the head flattened and thrust forward, but these genera have the lower calypters distinctly lobed and, in some cases, have the face convex.

Although there is a major division in the Plastotephritinae based on character states of the arista and vertical bristles, creating two tribes for this subfamily does not assist in clarifying the taxonomy further and thus seems pointless. To some extent various characters in genera such as *Rhegmatosaga* straddle the division. Nevertheless, the two Oriental genera can be easily separated by these characters as indicated in the following key. Although this is far from ideal, the real value of these characters will be apparent in the key to genera of the World (yet to be published).

1. Arista pubescent; inner and outer vertical bristles present ..... *Agadasys* gen. n.
- Arista short plumose; outer vertical bristles present, inner vertical bristles reduced and hair-like, often indistinguishable from post-ocellars ..... *Rhegmatosaga* (Frey, 1930)

Although this separation works for the two known Oriental genera, inclusion of new material from the this Region, may introduce conflicting characters and preclude its use in the future. The following key to genera is preferred, since it makes use of the diagnostic characters and will allow the reader to identify possible new genera.

#### KEY TO ORIENTAL GENERA

1. Fore and mid femora without a ventral row of short black bristles; eye distinctly haired (fig. 1); ocellar triangle elongate, strongly raised above frons, with three pairs of thick ocellar bristles (a white pair anterior to the lateral ocelli, a black pair above the lateral ocelli and a posterior white pair behind the median ocelli, fig. 1); two pairs of

scutellar bristles (figs. 4, 5); abdomen sclerotized so that dried specimens retain their shape, densely covered in setulae, with distinct tufts of black setulae and with white setulae interspersed along the margins of the tergites (fig. 8) .....

- ..... *Agadasys* gen. n.
- Fore and mid femora of males and fore femur of females having a ventral row of short black bristles (figs. 21, 22); eyes very finely setose (figs. 18–20); ocellar triangle short, its base sunken below the upper eye margin, with one pair of ocellar bristles; three pairs of scutellar bristles (fig. 20); abdomen weakly sclerotized, prone to collapse or to become misshapen in dried specimens, not unusually setose (fig. 25) .....
- ..... *Rhegmatosaga* (Frey, 1930)

#### *Agadasys* gen. n. (figs. 1–17)

Type species: *Agadasys hexablepharis* sp. n. by monotypy.

#### **Etymology**

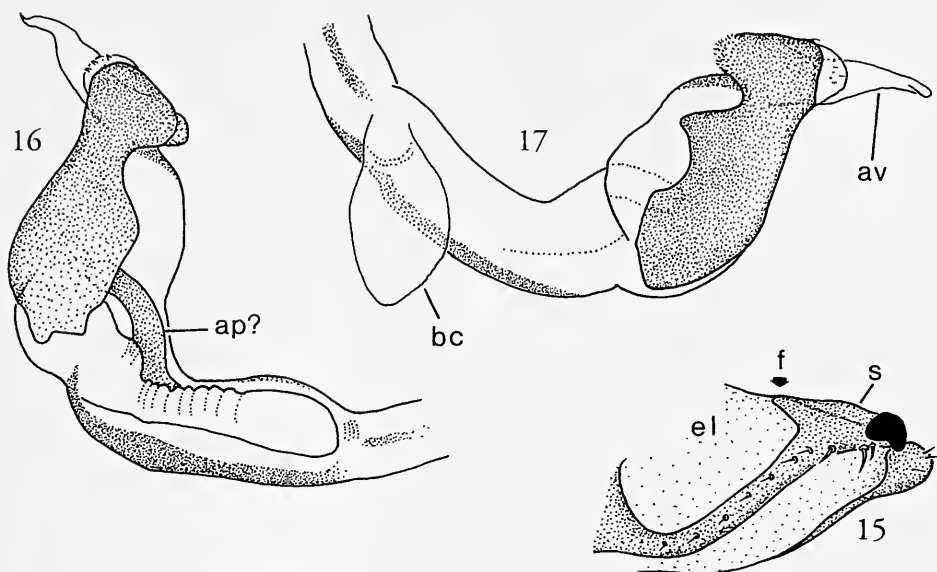
*Ag* derived from Greek *agan* – very or very much; Greek *dasy* (f) – shaggy, thickly haired; so named because of the three pairs of ocellar bristles and dense setulae on the abdomen. Gender feminine.

#### **Diagnosis**

Eye distinctly haired; ocellar triangle elongate, strongly raised above frons, with three pairs of thick ocellar bristles; two fronto-orbitals strongly thickened (in lateral view); two pairs of scutellar bristles; abdomen with heavy white and black setulae along the midline, interspersed with and longer than the long background setulae.

#### **Description**

Colour and pruinosity. – Ground colour predominantly pale creamy contrasting with grey-brown and dark brown markings on thoracic notum and pleurites and on abdominal tergites. Head: slightly darker and duller than ground colour, pilinal hemisphere darker yellow than surrounding colour of frons; A.s.3 grey towards apex, arista pale buff, brown toward apex. Ventral half of palp brown. Scutellum yellowish cream. Pulvillae creamy-white. Wings hyaline; marked with dark brown superimposing a radial pattern over the veins (fig. 7); veins dark brown except costa, R<sub>1</sub> and basal portions which are pale brown to buff where membrane is hyaline. Calypter white. Halter pale creamy-white. Sternites brown, setose; pleurites membranous, pale cream. Male postabdomen: glossy brown. Pruinosity well defined, silver-grey; present in antennal grooves and lateral portions of vertex, but absent from remainder of face and me-



Figs. 15-17. *Agadasys hexablepharis* sp. n. male postabdominal structures – 15, inner view of the left surstylus and epandrial lobe; 16, glans in lateral view from the left side; 17, glans in lateral view from the right side. Abbreviations: ap? = acophallus?; av = membranous apical vesicle; bc = basal caecum; el = epandrial lobe; f+ arrow = point of fusion between the epandrial lobe and the surstylus; s = surstylus. Scale bar = 0.5mm.

dian vertex posterior to ocellar triangle.

Head (fig. 1-3). – Subrectangular, face a little concave; buccal margin not extending to beyond level of apex of A.s.2. Ocellar triangle positioned anterior to fronto-orbitals, ocelli small in diameter (approximating diameter of ocellar bristle sockets). Eye elongate. Vertex one third of head width; head width three quarters of thorax width, lateral lobes of vertex not much raised and not visible above eye margin in lateral view. Antennal grooves shallow. Fringe of setulae on ventral surface of A.s.2 strongly developed. Gena in frontal view with a curved margin between the lower margin of eye and buccal cavity. Palp elongate, many times longer than wide. Postgena developed posteriorly such that it bulges posterior to eye. Setulae generally long and dense; a peribuccal row of black setulae extending dorsally in an arc to form a facial row; black setulae on apicodorsal part of postgenal and on apicoventral half of palp; brown setulae on ocellar triangle well developed. Vertex asetose medially. Bristles: three ocellars (anterior pair white, median pair black and posterior pair white), two black fronto-orbitals, two verticals (inner white, outer black), one strong white postocellar, one white buccal, one fine white A.s.2. Postocular row black, well developed.

Thorax (figs. 4, 5). – Setulae long and dense, white, intermingled with black setulae in irregular patches on notum and pleurites; long setulae absent from postalar wall, posterior half of pleurotergite, meron, postnotum and subscutellum; bristle-like erect white setulae along margin, on disc and at apex of scutellum. Scutellum convex and strongly rounded at margin. Bristles: – 2 notopleural (posterior one on raised callus), one mesopleural, one supra-alar, one postalar, one intrapostalar, one weak posterior acrostichal and one weak posterior dorsocentral, one lateral and one apical scutellar (lateral placed dorsal to, and apical inserted ventral to midline of margin).

Legs. – Setulae long, white, interspersed with black setulae, tending to be more bristle like on ventral surfaces of femora and dorsal surfaces of tibiae. Mid coxal prong pale and narrow, slightly curved, apically pointed (fig. 6). Fore femora aspinose; white setulae interspersed with black setulae on apex. Apex of fore tibia with a distinct comb of orange setulae. Ventral pre-apical spur on mid tibia surrounded by a row of sharply pointed setulae. Anterior margin of tarsomeres with short, thick, black pre-apical setulae.

Wing (fig. 7). – Costa with no distinct breaks, but having a humeral weakening. Setulae on costa inter-

mingled black and white, generally corresponding to light and dark patches on membrane as far as subcostal node, and black setulae intermingled with brown to apex, becoming shorter toward wing apex. Costal cell broad, wider than length of crossvein r-m. Subcosta complete, undulating near to humeral crossvein, weakened at wing flexion and bent toward costa at 50°-60°. Fine brown setulae along posterior wing margin. Long black setulae dorsally on entire  $R_1$ , and  $R_{4,5}$  and on r-m junction with discal portion of M; ventrally on RS and base of  $R_{4,5}$ . Wing flexion noticeable as a hyaline band through weakenings of subcosta, RS, M, and Cu at apex of bm. Crossvein r-m a little before midway on dc. Cell bm longer than cell cup; apex of cup rounded. Anal vein almost reaching wing margin. Lower calypter reduced to setose ridge, upper calypter well developed, margin undulating. Tegula small with long black and white bristle-like setulae.

Abdomen (fig. 8). – Ovale, widest at hind margin of tergite one and two. Sternites reduced to less than one third the width of abdomen. Setulae long and dense, a mixture of black and white, in longer tufts along midline of tergites three to five and only white on middle of posterior margin of tergite one and two. Sternite five v-shaped in male (fig. 10); sternite six broadly T-shaped in female (fig. 14).

Male postabdomen (figs. 9, 10, 15-17). – Epandrium small, trapezoid, distally produced into apical lobe with dorsal margin continuous with that of main body of epandrium; protiger membranous, raised above sides of epandrium. Cerci fused, forming a shield above the surstyli. Surstylus single, basally narrow, sinuous, apically weakly sclerotized. Stipe of aedeagus narrow, with annular impressions on inner surface. Preglans well developed, slightly sclerotized.

Female postabdomen (figs. 11-13). – Oviscape conical, slightly shorter dorsally than ventrally; eversible ovipositor sheath finely ornamented; aculeus blunt ended, setose at apex and along shaft; spermathecae and ovaries not observed, but only two oviducts present at apex of vagina.

Included species. – *Agadasys hexablepharis* sp. n.

Distribution. – This genus is recorded from Vietnam, Thailand and India.

### *Agadasys hexablepharis* sp. n.

(figs. 1-17)

#### **Etymology**

Greek *hex* – six; Greek *blepharis* (f.) – eyelash, referring to the unusual occurrence of six ocellar bristles.

#### **Diagnosis**

Setulae on  $R_1$  long, as long as distance across bases of three setulae. Mesopleural bristle long, reaching base of calypter.

#### **Description**

Dimensions. – Female holotype: body length 5.3 mm; wing length 5.1 mm.

Colour and pruinosity. – Upper third of post orbital sclerite dark brown. Ocellar triangle ochre. Notum with four dark brown square marks (fig. 4), one over each transverse suture and notopleural callosity, one frontomedial and one posteromedial, each surrounded by smoky-grey; both marks over notopleural callosity continue ventrally across anterior mesopleuron to upper apical corner of sternopleuron; sternopleuron, pteropleurite, pleurotergite, metapleuron and postnotum brown; subscutellum suffused with red-brown. Legs: faintly banded with brown basad of midpoint on tibiae; mid and hind coxae brown; hind femora with basal brown band. Basal portion of tergite one plus two dark brown, tergites three, four and five with brown and grey-brown marks across each tergite medially and laterally, amount of pale ground colour diminishing toward apex of abdomen (fig. 8).

Head (figs. 1-3). – Eye densely setose. Outer ventral setulae on A.s.2. long, reaching one third along A.s.3. Arista pubescent. Postocular plate rounded. Gena developed ventrally, equal to width of A.s.3. Setulae brown on ocellar triangle, along dorsal eye margin from ptilinum to vertex and on dorsal portion of postgena; white on anterior and lateral margins of ocellar triangle and on ventral portion of postgena. Bristles: as in generic description; frontorbitals reclinate, but inclined slightly laterally. Post ocular row three lines of setulae deep.

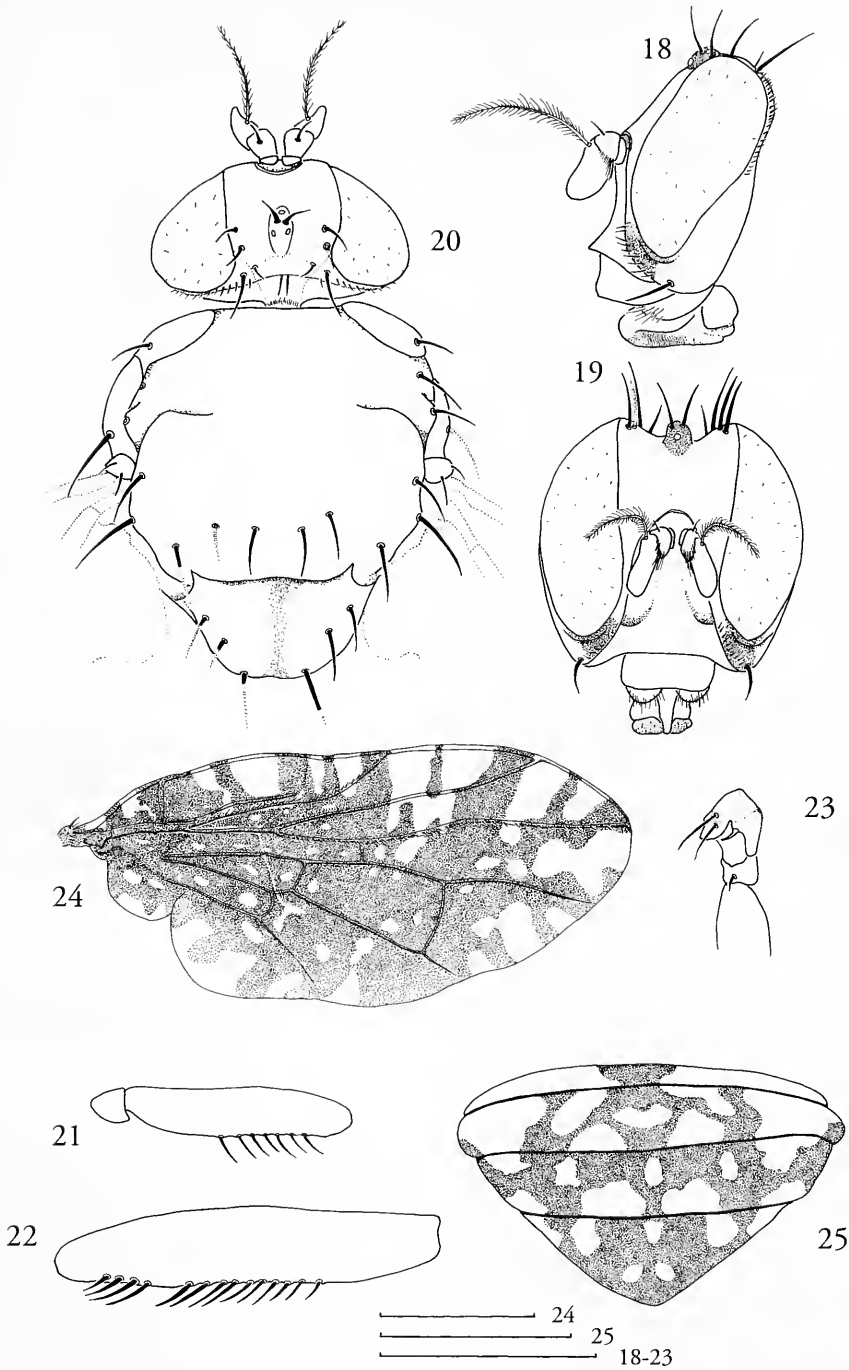
Thorax. – Scutellum apical margin and dorsal midline with shallow depression (fig. 5). Bristles: as in generic description.

Legs. – Two apical white fore coxal setulae, two dorsal white mid coxal setulae (fig. 6) and one dorsal white hind coxal setula. White setulae interspersed with black setulae on apex of fore and mid femora, at apex of tibiae and on faint marks on tibiae of all legs.

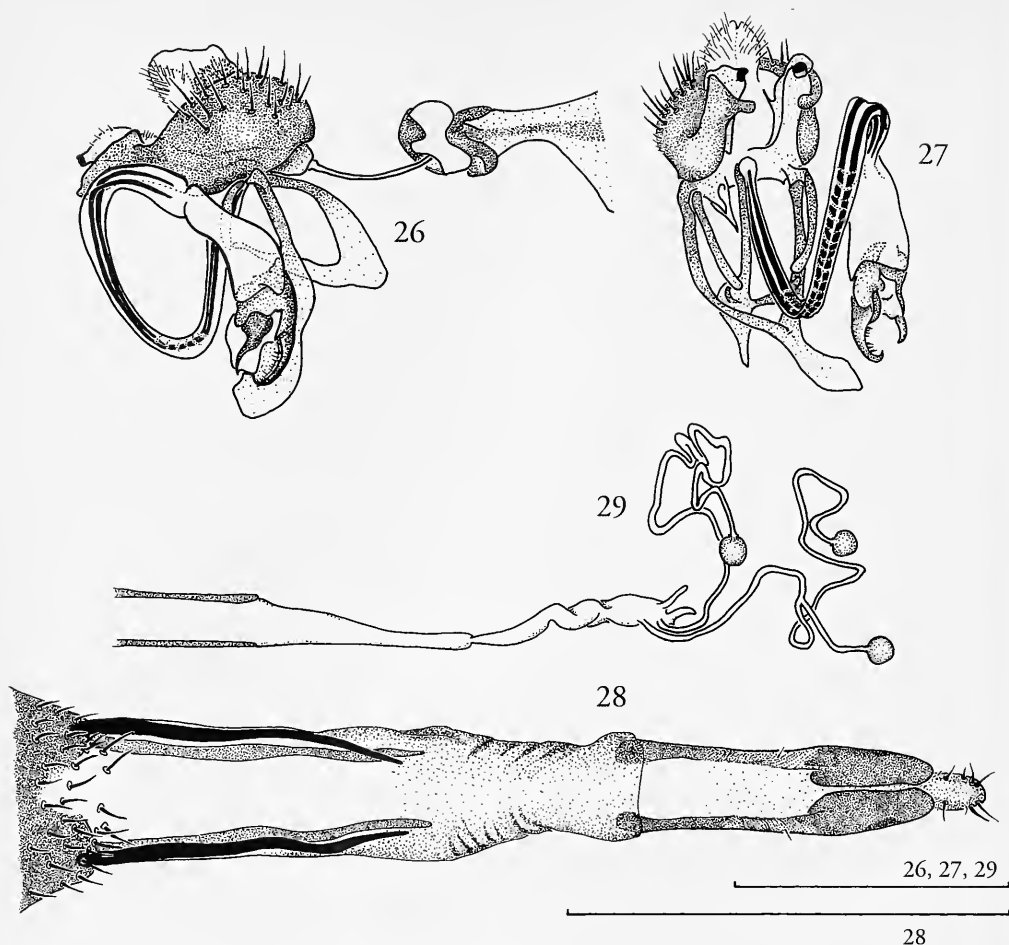
Wings. – Black setulae on  $R_1$  long, and those on r-m positioned from junction of r-m with M to apex of discal portion of M.

Abdomen. – As in generic description.

Female postabdomen. – Tergite six absent, intersegmental membrane folded under tergite five; oviscape with two pairs of long bristles at apex of dorsal margin; eversible ovipositor sheath ornamented on apical half with fine wrinkles; apex of aculeus blunt ended, with four long apical setulae, two minute lateral apicals basad of long apicals and four subapicals, base of aculeus with two subapical and two median setulae (figs. 11-12); spermathecae not observed, but two ducts apparent at apex of vagina (fig. 13); ovaries not observed; ventral receptacle small and rounded, situated basally on vaginal wall.



Figs. 18-25. *Rhagmatosaga latiuscula* (Walker, 1856). – 18, head in lateral view; 19, head in frontal view; 20, head and thorax in dorsal view; 21, posterior surface of right fore femur; 22, posterior surface of left mid femur; 23, left mid-coxa; 24, right wing in dorsal view; 25, abdomen in dorsal view. Scale bars = 1mm.



Figs. 26-29. *Rhagmatosaga latiuscula* (Walker, 1856) postabdominal structures. – 26, male genitalia in lateral view; 27, male genitalia in ventral oblique view; 28, female genitalia in ventral view; 29, female internal genital tract. Scale bars = 1 mm.

Variation. – Male body length 4.4 mm, wing length 4.8 mm; female body length 4.3-5.3 mm, wing length 4.5-5.1 mm. Brown patches on the notum may be more extensive and the apex of the hind tibiae sometimes have a brown band. In male specimens the distinct hairs on the eyes are mostly missing, presumed rubbed off, with only a few hairs remaining. The inner surface of the male hind trochanter is apically pointed, but lacking a prong (this is relevant in comparison with some African species).

Male postabdomen (fig. 9-10, 15-17). – Epandrium blunt apically and curved gently around in front of surstyli, strongly setose dorsally, proctiger sub-

square; cerci apically rounded, setose along margin and apex, raised at a slight angle to the epandrial margin; surstylus apically blunt; arms of fultella and genital ring narrow; ejaculatory apodeme narrowly spatulate, sclerotized throughout, but more so basally; preglans elongate; apex of glans with paired terminal lobes between which rises a partially sclerotized apical spur, apical vesicle pointed.

Type material examined. – Holotype ♀: 'THAILAND: Phangnga / Prov.(vic. of Amphoe / Muang Phangnga town) / 08°28-29'N 98°32'E' [printed on white card]; '6 June 1969 / Malaise trap / John J.S. Burton' [printed on white card]; 'HOLOTYPE /

*Agadasy* / *hexablepharis* / sp. n. ♀ / Det. Whittington' [first and last lines printed, middle three hand written on red card] (BPBM). – Paratypes: INDIA: 1 ♂: – Sylhet [24°53'N 91°51'E], i.1914, Ianson [collector], C.T. Trechmann Bequest B.M. 1964-549 (BMNH); THAILAND: 1 ♀: Trang Province [07°30'N 99°18'E], Khaophappa Khaochang, 200m, 11-15.i.1964, G.A. Samuelson, Malaise trap (BPBM); VIETNAM: 1 ♂?: Tay Ninh Province [ca. 11°18'N 106°06'E], Nui Ba Den (Black Virgin Mountains), 6-8.viii.1970, A.R. Gillogly, 975m (3200 ft) (AMSA).

## Discussion

The holotype has the apical half of the right wing missing and the post-abdomen dissected and stored in glycerine, in a microvial pinned with the specimen.

This is the only species known in this distinctive Oriental genus, distributed in India, Vietnam and Thailand. The Vietnam specimen has the abdomen folded under, thus making the genitalia indiscernible, but I consider it to be a male.

In female *Plastotephritinae*, there are usually three spermathecae arranged in a 2+1 fashion. Thus, the presence of two spermathecal ducts in this species, is considered sufficient evidence that *A. hexablepharis* has three spermathecae.

## *Rhegmatosaga* Frey, 1930 (figs. 18-32)

*Rhegmatosaga* Frey, 1930: 63. Type species: *Rhegmatosaga insignis* Frey, 1930, by original designation [= *latiuscula* (Walker, 1856)]; Bezzi 1918: 246 [mention of specimens attributed to *Ortalidae*]; Frey 1932: 256 [discussion]; Hardy 1959: 191, 231 [new combination; new synonymy]; Steyskal 1977: 136 [catalogue].

## Etymology

*Rhegmatos* Gr. f.- break, *sagos* L.n. – cloak, mantle – perhaps referring to the mottled appearance of the abdomen of members of this genus. Gender feminine.

## Diagnosis

Inner vertical bristle reduced and setula-like; fore and mid femora of males and fore femur of females having a ventral row of short black bristles; costal cell broad, the distance from C to  $R_1$  twice the dimension of r-m; abdomen weakly sclerotized, prone to collapse or to become misshapen in dried specimens.

## Description

Dimensions. – Body length 2.9-3.9 mm; wing length 3.0-4.0 mm.

Colour and pruinosity. – Ground-colour dark brown; head and bands on tibiae pale cream or buff; wings brown, spotted with hyaline marks (fig. 24). Eyes reddish-brown. Antennae buff tinged grey-

brown at apex of A.s.3. Mouthparts brown ventrally. Calypter white; halteres pale-buff. Abdominal tergites mottled (fig. 25). Abdominal pleurites buff, sternites brown. Grey pruinescence dominant over ground colour on notum and abdominal tergites.

Head (figs. 18-20). – Elongate and antero-posteriorly compressed, vertex much narrower than thorax. Face indented slightly under antennae, but epistome projects only a little at margin. Eyes elongate, oval. A shallow, poorly developed groove present below eye. Frons broadening dorsally. Ocellar triangle positioned anterior to fronto-orbitals. Antennae pendulant, A.s.1 set a little below midway down length of head; arista plumose. A.s.2. with a lateralventral fringe of long pale setulae. Middle of vertex slightly sunken below level of top margin of eye. Postgena slightly swollen, roughly equal to width across the lower quarter of eye. Palp flattened, strongly setose. Bristles: one ocellar, two strong reclinate fronto-orbitals, one strong outer and one weak pale inner vertical, one pale postocellar, one dorsal on A.s.2. and one buccal. Postocular row pale, indistinct from occipital setulae.

Thorax (fig. 20). – Setulae short, pale on anterolateral margins and pre-sutural notum, black on post-sutural notum, with sparser pruinescence surrounding alveoli; longer on pleurites, generally pale with some brown setulae on mesopleuron, pleurotergite, scutellum and around coxae. Bristles: one humeral, two notopleural (posterior one on raised callus), one mesopleural, one supra-alar, one postalar, one intra-alar, one prescutellar ac and dc, two lateral and one subapical scutellars.

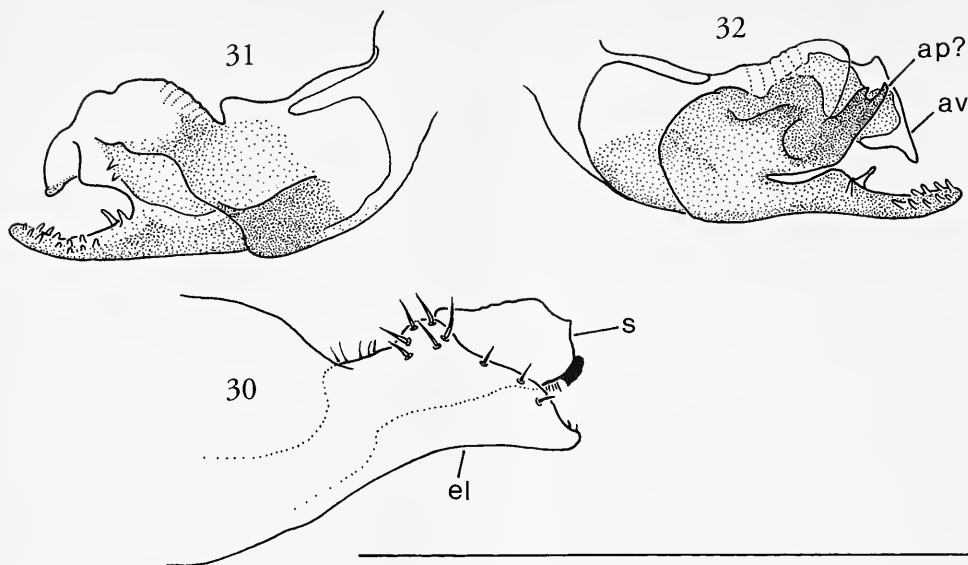
Legs. – Fore and mid femora with anteroventral and posteroventral rows of short black bristles (figs. 21, 22); mid-coxal prong narrow, pointed and pale coloured (fig. 23). Anterior margin of tarsomeres with short black preapical setulae.

Wing (fig. 24). – Costa with pre-humeral weakening, but without a distinct break, marked by a change in costal-setula length. Costal cell broad. Subcosta sinuous basally, ending abruptly distally, beyond which membrane is distinctly folded until junction with Costa. Setulae dorsally on entire length of  $R_1$  and  $R_{4+5}$ .  $R_1$  slightly sinuous;  $R_{4+5}$  arching forward slightly.

Abdomen. – Pleurites densely covered with short, black setulae.

Male postabdomen (figs. 26, 27, 30-32). – Epan-drium rounded; preglans present, unsclerotized; glans with terminal claw-like lobes; base of ejaculatory apodeme membranous, but partially sclerotized, large and bulbous.

Female postabdomen (figs. 28, 29). – Tergite six absent; oviscape conical, shorter dorsally than ventrally; eversible ovipositor sheath ornamented on median membranous section with fine bumps; aculeus finely



Figs. 30-32. *Rhegmatosaga latiuscula* (Walker, 1856). – 30, outer view of the apex of the epandrial lobe and surstylus; 31, glans in lateral view from the left side; 32, glans in lateral view from the right side. Abbreviations: ap? = acophallus?; av = membranous apical vesicle; el = epandrial lobe; s = surstylus. Scale bar = 0.5 mm.

ornamented with wrinkles along lateral margin, tip blunt, with one pair of fine basal setulae and two pairs of strong, and 1 pair of very small apical setulae; three spherical spermathecae; one spermathecal duct free for entire length remaining two joined with unequal terminal sections of duct (fig. 29).

Included species. – *Rhegmatosaga latiuscula* (Walker, 1856).

## Discussion

*Rhegmatosaga insignis* Frey, 1930 was designated by Frey (1930) as the type species of *Rhegmatosaga*. Hardy (1959) examined Walker's types of Tephritidae and transferred *Noeeta latiuscula* Walker, 1856 from *Noeeta* to *Rhegmatosaga* by synonymizing it with *R. insignis*.

Bezzi (1918) mentioned specimens from the Philippine Islands collected by Prof. C. F. Baker (see Other Material under *R. latiuscula* below), stating that these were allied to *Cladoderris* Bezzi, 1914 and *Agrochira* (*Mesanothin*) *tephritina* (Enderlein, 1912) and would be better placed in the Ortaliidae. The family concepts have since changed and all three genera belong to the Plastotephritinae. Other than this placement there is no indication that these genera share a close evolutionary affinity, since a phylogenetic assessment of the Plastotephritinae has yet to be carried out.

## Distribution

This is an Oriental genus, distributed from Laos to the Philippines.

## *Rhegmatosaga latiuscula* (Walker, 1856) (figs. 18-32)

*Noeeta latiuscula* Walker, 1856b: 133 [generic misidentification]; Hardy 1959: 191 & 231 [correction].

*Rhegmatosaga insignis* Frey, 1930: 63, fig. 8 (wing); Hardy 1959: 191 & 231 [new synonymy]; Steyskal 1977: 136 [catalogue]

*Rhegmatosaga latiuscula* (Walker, 1856); Hardy 1959: 231 [new combination]; Steyskal 1977: 136 [catalogue].

## Etymology

Latin *latiuscula* – slightly broad, possibly referring to the broad costa cell of the wing.

## Diagnosis

Eye bare; pruinescence predominantly grey; bristles of mid femur in a long medial and a short apical series.

## Description

Dimensions. – Male holotype: body length 3.2 mm; wing length 3.4 mm.

Colour and pruinosity. – Ground-colour dark brown. Head cream; antenna, pilinal area, palp and dorsal surface of labellum slightly yellow; ground-

colour restricted to ocellar triangle, narrow band on gena and epistomal margin below eye and ventral surface of labellum, A.s.3 tinged grey-brown apically; postorbital sclerite mostly dark brown, but pale creamy-white adjacent to margin of eye; median occipital sclerite pale creamy-white. Scutellum with faint yellow-brown spots at base and along margin. Fore coxae pale buff apically. Tibiae with two medial pale-buff bands: at about two fifths and four fifths from base. Tarsomeres one and two pale-buff, remaining tarsomeres pale-brown. Wings speckled brown and hyaline (fig. 24), veins pale at hyaline areas of membrane and brown across dark brown markings. Tergites one and two pale-buff on distal margin with median black band (fig. 25). Male postabdomen brown. Silver pruinescence inconspicuous on most of head. Conspicuous grey pruinescence on notum and base of scutellum, but distinctly absent from alveoli; six poorly defined bronze-brown pruinescence markings on notum giving a mottled impression. Mesopleuron with a dense silver pruinose band across it from fore coxa to wing base. Abdominal tergites densely grey pruinose mottled with bronze-brown pruinescence (fig. 25).

Head (figs. 18-20). – Vertex concave between eye margins and ocellar triangle; face slightly concave at base, epistomal margin protruding as far as A.s.2; arista twice as long as of A.s.3, short and densely plumose. Palp broad. Occiput shallow, postgena swollen. Setulae pale, short on front of head, longer on postgena, palp, labellum and ventral margin of A.s.2; parafrontals black.

Thorax (fig. 20). – Scutellum with a distinct furrow along median line.

Legs. – Row of bristles on fore femur long and thin, arranged in a single series on posteroventral surface (fig. 21); bristles of mid femora in anteroventral position, divided into a short apical series of three bristles and a longer medial series of six bristles (left leg). Setulae of legs brown, sometimes pale on bands of ground-colour. Mid and hind coxae each with two bristles; mid coxa with short, curved prong (fig. 23); mid trochanter with a short terminal bristle.

Wings. – Costal cell broad, the distance from C to  $R_1$  twice the length of r-m; Sc,  $R_{2+3}$  and  $R_{4+5}$  slightly sinuoid; Sc evanescent at flexion line; r-m positioned slightly basad of midway on dc; cup shorter than bm; apical crossveins of cup and dc curved.

Abdomen (fig. 25). – Setulae generally pale, black on tergite five.

Male postabdomen (figs. 26, 27, 30-32). – Epanthrium rounded, evenly covered with black setulae, distally produced into an elongate apical lobe, blunt ended, curved around in front of surstylus, with a small apical projection raised midway along length into a triangular lobe that is fused with surstylus.

Proctiger subsquare, fused with cerci. Cerci fused along midline and fused to proctiger, strongly setose ventrally. Apex of surstylus with a strongly sclerotized bar (fig. 30), inner margin of stem of surstylus raised as a shallow ridge with short setulae near apex. Stipe of aedeagus narrow. Preglans conical, unsclerotized, about, twice width of stipe. Glans divided into a complex array of processes, single terminal lobes present ventrally, with a double row of peg-like setulae; membranous apical vesicle present dorsally; possible acrophallus projecting dorsally at base of vesicle (fig. 32). Ejaculatory apodeme, strongly sclerotized (damaged in dissection) and a large bulbous partially sclerotized basal lobe attached to a short, unsclerotized ejaculatory duct. Arms of fultella and genital ring narrow, apices spatulate and poorly sclerotized (fig. 26, 27).

Variation. – Male body length: 2.9-3.9 mm; wing length: 3.0-4.0 mm; female body length: 3.0-3.5 mm; wing length: 3.2-3.6 mm. The specimen from Laos has a hyaline spot in the subcostal band connected to the hyaline area basad to that band and some small difference in mottling on abdomen. Some specimens have pruinescence more clearly defined, showing a strong line of silver-grey pruinescence along the median furrow of the scutellum and sometimes some marginal spots. The number of apical and median bristles in the rows on the male mid femur varies from 3-5 and 6-8 (fig. 22) respectively and may differ on the legs of an individual specimen. Furthermore, the distinction between the medial and apical series is not always well defined. Female specimens have fore and mid femoral bristles poorly developed and almost setula-like on mid leg.

Female postabdomen as in generic description (figs. 28, 29).

Type material examined. – Holotype ♂: BORNEO: 'Type' [printed round label with green border]; 'SHR' [handwritten, round label]; '684' [printed, small rectangular label breaking in half]; '*latiuscula* / Wlk' [handwritten in black ink, folded in three]; 'Borneo / W.W. Saunders / B.M. 1868-4.' [handwritten in black ink, pin hole through first 8 of year]; '*Rhegmatosaga* / *latiuscula* / (Walker) / *R. insignis* Frey / is a / synonym / Det. 1954 / D.E. Hardy' [handwritten in black ink, with 'Det. 195' and 'D.E. Hardy' printed in line with 'is a' and 'synonym' respectively]; 'HOLOTYPE / *Rhegmatosaga* / *latiuscula* ♂ / (Walker, 1856) / Det: A.E. Whittington' [on red card, first and last lines printed in black ink, remainder handwritten] (BMNH).

Other Material. – LAOS: 1♂, Wapikhamthong Prov. / Wapi [possibly = Muang Vapi, 15°40'N 105°55'E], 15.iii.1967 Native Collector, RONDON—BISHOP MUS. COLLECTION, light trap (BFBM); VIETNAM: 1♀, Tay Ninh Province [ca. 11°18'N 106°06'E], Nui Ba Den (Black Virgin Mountains), 6-8.viii.1970, A.R. Gillogly 975m (3200 ft) (AMSA); PHILIPPINES: 1♂, 'Type' [printed on round label with red border]; 'Pres. by / Imp.Inst.Ent. / Brit.Mus. / 1931-56' [printed on white card]; '*Rhegmatosaga* / *insignis*

n.gen. / n.sp. Frey det.' [hand-written except for 'Frey det.']; '3902' [handwritten on small label]; 'Butuan [08°56'N 125°31'E] / Mindanao / Baker' [printed on white card]; 'Spec. typ. No. / ..... ' [printed on dusty-pink paper, with bold black line down left side and fine black line (partly cut off) along bottom] (BMNH); 1 ♀, same locality and collector as BMNH type (USNM, bearing a number '3905'); 1 ♂, 'Davao [07°05'N 125°38'E], Mindanao, Baker' [printed on white card]; '6433' [handwritten on small label]; 'Spec. typ. No... / ..... ' [printed on dusty-pink paper]; 'Mus. Zool. H:fors / Spec. typ. No 14080 / *Rhegmatosaga / insignis* Frey' [first two lines up to the numerals printed and numerals of second line plus following two lines hand-written in blue ink, all on pale blue paper] (MZHF); 3 ♂, 4 ♀, same locality and collector data as MZHF type (USNM, 1 ♀ also bearing a label with the number '6433').

## Discussion

The holotype specimen of *R. latiuscula* is in good condition (as reported by Hardy 1959), small amounts of fungus visible. It is staged on a rectangular piece of clear celluloid and the postabdomen was dissected and placed in glycerine in micro-capsule on pin. The original description by Walker (1856) appears in his paper on material collected by Mr A. R. Wallace. The label of the type specimen, however, bears the name W.W. Saunders. It is clear from the discussion by Saunders of Wallace's collecting (Walker 1856) that Wallace gave material to Saunders, who then incorporated it into his own collection. Thus the reference to Saunders on the label does not refer to the collector, but to the owner of the collection.

In the original description (Walker 1856) the scutellum and abdomen were described as brilliant and shining black. This is possibly the case in freshly caught material, although I have seen none. The scutellum of the holotype is dark-brown now and has lost the grey pruinosity that is evident in other specimens, especially along the median furrow. Likewise the abdomen is dark brown and both it and the scutellum may have faded since the specimen was first described.

Contrary to Frey (1930), the syntype specimens of *Rhegmatosaga insignis* Frey, 1930 are in separate institutions. Both specimens are male, one is in BMNH (London) and the other is in MZHF (Helsinki).

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<sup>1</sup> *Hydrotrepes makros* 'sp. n.' was listed by mistake in the abstract of Nieser & Chen (page 77), the name does not exist.



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- Johansson R. & E. S. Nielsen, 1990. Tribus Nepticulini. – In: Johansson, R. et al. The Nepticulidae and Opostegidae (Lepidoptera) of NW Europe. – *Fauna Entomologica Scandinavica* 23: 111-238, pls.

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